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# SELECTED

# **ESOURCES**ABSTRACTS

VOLUME 4, NUMBER 16 AUGUST 15, 1971 SELECTED WATER RESOURCES ABSTRACTS is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the National Technical Information Service (NTIS), U.S. Department of Commerce. NTIS was established September 2, 1970, as a new primary operating unit under the Assistant Secretary of Commerce for Science and Technology to improve public access to the many products and services of the Department. Information services for Federal scientific and technical report literature previously provided by the Clearinghouse for Federal Scientific and Technical Information will now be provided by NTIS.

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# SELECTED WATER RESOURCES ABSTRACTS

'A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Resources Research, U.S. Department of the Interior



VOLUME 4, NUMBER 16 AUGUST 15, 1971

W71-08322 -- W71-08941

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

# FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the Water Resources Thesaurus (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT PRESENTLY IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency, Water Quality Office. A directory of the Centers appears on inside back cover.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center Office of Water Resources Research U.S. Department of the Interior Washington, D. C. 20240

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## 03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

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Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

# **06 WATER RESOURCES PLANNING**

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## 07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

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## 09 MANPOWER, GRANTS, AND FACILITIES

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# SELECTED WATER RESOURCES ABSTRACTS

#### 01. NATURE OF WATER

## 1B. Aqueous Solutions and Suspensions

REACTIONS OF A STRONGLY BASIC ION EXCHANGE RESIN WITH DILUTE AQUEOUS SOLUTIONS IN A COLUMNAR SYSTEM, Michigan Univ., Ann Arbor. Div. of Sanitary and Water Resources Engineering. For primary bibliographic entry see Field 05D. W71-08391

# 02. WATER CYCLE

#### 2A. General

NATIONAL HYDROLOGIC BENCH-

MARK NETWORK,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07A.
W71-08327

INTERNATIONAL HYDROLOGICAL DECADE YEARBOOK OF THE FEDERAL REPUBLIC OF GERMANY-CALENDAR YEAR 1967. For primary bibliographic entry see Field 07C. W71-08346

DRAINAGE PATTERN ANALYSIS, SOUTHERN HIGH PLAINS, WEST TEXAS AND EASTERN NEW MEXICO,

Texas Technological Coll. Lubbock. Dept. of

For primary bibliographic entry see Field 02F. W71-08354

PROBLEMS OF HYDROLOGIC FORECASTS AND COMPUTATIONS (RUSSIAN: VOPROSY GIDROLOGICHESKIKH PROGNOZOV

RASCHETOV), For primary bibliographic entry see Field 04A. W71-08374

WATER RESOURCES AND WATER BALANCE OF THE UKRAINE AND MOLDAVIA (RUSSIAN: VODNYYE RESURSY I BALANS VOD UKRAINY I MOLDAVII),

For primary bibliographic entry see Field 04A. W71-08388

#### NUMERICAL SIMULATION OF WATERSHED HYDROLOGY,

Texas Univ., Austin. Dept. of Civil Engineering.

B. J. Claborn, and Walter L. Moore.

Available from the National Technical Information Available from the National Technical International Service as PB-199 644, \$3.00 in paper copy, \$0.95 in microfiche. Hydraulic Engineering Laboratory Technical Report HYD 14-7001, Aug 1970, 225 p, 49 fig, 4 ref, 2 append. OWRR Project B-015-TEX

Descriptors: \*Water-beds (Basins), \*Model studies, \*Demonstration watersheds, Computer models, Mathematical models, \*Synthetic hydrology, \*Simulation analysis, Dynamic programming, Numerical analysis.

Identifiers: Stanford waterbed model, \*Watershed

This research developed methods for a numerical simulation of watersheds which will be both operational from the standpoint of engineering usage and realistic from the standpoint of simulating physical processes occurring in the watershed. The Standord Watershed Model has been reviewed and used as a pattern for developing a new watershed simula-tion model. The new model incorporates con-siderable flexibility of input data and model time steps which were not available in the Standford

Model. In making a detailed translation of the model into Fortran IV compiler language, a nearly complete understanding of the model was achieved and has been presented as a part of the report. New parameters describing the infiltration, evaporation, and soil water movement processes have been defined and related to physical properties of the watershed where possible. Application to two experimental watersheds are reported.

W71-08392

HYDROLOGICAL RESEARCH IN SOUTH

University of the Witwaterstrand, Johannesburg (South Africa). Dept. of Civil Engineering. For primary bibliographic entry see Field 06B. W71-08466

#### EXPERIMENT IN DETERMINISTIC WATERSHED MODELING,

Montana State Univ., Bozeman. Dept. of Earth

Darrel E. Dunn.

Water Resources Bulletin, Vol 7, No 2, p 343-347, Apr 1971. 5 p, 1 fig, 6 ref. OWRR Project A-025-MONT (2).

Descriptors: \*Mathematical models, \*Rainfall-ru-noff relationships, \*Simulation analysis, Routing, Numerical analysis, Computer programs. Identifiers: Deterministic models, Finite difference

An experimental three-dimensional watershed model in the form of a Fortran IV program was constructed. The model was an oversimplified one which divided the watershed volume into layers of cells which represented the overland flow, the vadose, and the phreatic zones. Water budget equations which utilized such formulas as Darcy's law and Manning's equation were applied to each interior cell. The resulting set of simultaneous equations was solved for heads at the end of successive time increments. This information was transformed to streamflow and other hydrologic output. Input was weather data, which effected appropriate adjustments in the cells representing the surfacewater and vadose zones. After testing the model, it was concluded that this type of model is indesirably sensitive to cell size and length of time increment. In spite of the deficiencies of this primitive model, this general kind of approach to modeling seems promising, but it may be necessary to devise new transport equations which apply to more natural divisions of watersheds. (Knapp-USGS) W71-08531

OBSERVATIONS OF THE EFFECT OF EXTREME HIGH WATER IN 1965 AND 1966 ON THE GROUNDWATER BODY OF THE LIENZ BASIN-EAST TIROL (GERMAN: BEOBACHTUNGEN UBER DIE AUSWIRKUNG DER EXTREMEN HOCHWASSER 1965 UND 1966 AUF DEN GRUNDWASSERKORPER IM BECKEN VON LIENZ (OSTTIROL),

G. Platzer. English abstract. Steirische Beitrage zur Hydrogeologie, No 20, Graz, p 81-98, 1968. 18 p, 6 fig, 2 tab, 7 ref.

Descriptors: \*Surface-groundwater relationships, \*Floods, \*Groundwater recharge, \*Water levels, Rainfall-runoff relationships, Water level fluctua-tions, Groundwater basins, Water storage, Water temperature, Water chemistry. Identifiers: \*Lienz (Austria), \*Austria.

The groundwater body of Lienz and the surrounding districts extends on both sides of the river Drau from the mouth of the Pustertal at Leisach to the border between the provinces of Carinthia and Tirol, Austria. The basin is bordered by steep mountains, over 2000 m high, consisting of crystalline schists and mexozoic rocks, and it is connected with other groundwater bodies only at three narrow points of the Drau and Isel valleys. The reservoir

covers an area of 35 sq km, is approximately 16 km long and up to 4 km wide, and is situated in quarternary deposits of unknown thickness. The reservoir has one underground outlet in the western part, and an underground and surface outlet of approximately the same size in the eastern part. The proximately the same size in the eastern part. The groundwater discharge is min. 3 cu m/sec. Average rainfall is 900 to 2000 mm per annum. The three floods of September 1965, August and November 1966 with a measured rainfall of 144-259 mm had a great effect on the groundwater body. The groundwater tables rose up to 4.80 m. The flow direction changed up to 90%. A raise of groundwater temperature of 0.9 to 2 deg. C. was also recorded in some wells after the floods. Even more distributions to the above of the above the share of the significant was the change of the chemical characteristics of the groundwater. The pH-value, the electrolytic conductivity, the total hardness, the carbonate and noncarbonate hardness increased considerably. (Knapp-USGS)

# EFFECTS OF AREAL AND TIME DISTRIBUTION OF RAINFALL ON SMALL WATERSHED RUNOFF HYDROGRAPHS,

Minnesota Univ., Minneapolis. Dept. of Agricul-

Minnesota Univ., Minneapoiis. Dept. of Agricultural Engineering.
T. C. Wei, and C. L. Larson.
Available from the National Technical Information
Service as PB-199 837, \$3.00 in paper copy, \$0.95
in microfiche. Minnesota Water Resources
Research Center, Bulletin 30, 1971. 118 p, 31 fig,
28 tab, 71 ref. OWRR Project A-017-MINN (2).

Descriptors: \*Rainfall-runoff relationships. Descriptors: \*Kainfall-runoff relationships, \*Mathematical model, \*Peak discharges, Watershed, Minnesota, Climate, Precipitation, Hydrographs, Storm runoff, Routing, Computer, Overland flow, Channels, Geology, Soil types,

Topography.
Identifiers: \*Watershed model, \*Rainfall excess,
\*Storm movement, Lag time, Time distribution, Areal distribution.

A mathematical watershed model of 1.456 square miles was developed to route runoff through overland flow and through the channel system. Excess rainfall was used as input data and the flow was routed by the successive numerical solution of the kinematic wave equations to produce outflow hydrographs for elementary (first order) watersheds. These hydrographs were used as input to the channel system where the flow was routed by the successive numerical solution of the dynamic wave equations to yield the outflow hydrograph for the model watershed. Backwater effects were considered at most of the junctions of the model watershed. The model was used to study the effects of time distribution and areal distribution of rainfall, storm movement and watershed shape on the runoff hydrograph. In each study, attempts were made to find a relationship between an appropriate input parameter and a modification (peak flow) coefficient, to be used in adjusting the peak flow) conventional methods, which normally assume a stationary, constant intensity storm uniformly distributed over the watershed. The results of this study indicate that, in general, the selected factors have significant effects on peak discharge. (Walton-Minnesota) W71-08664

#### 2B. Precipitation

A NEW SYSTEM FOR THE AUTOMATIC MEASUREMENT AND RECORDING OF RAINFALL, Royal Aircraft Establishment, Farnborough (England).

For primary bibliographic entry see Field 07B. W71-08339

CALCULATED AND OBSERVED CHANGES IN SEA SURFACE TEMPERATURE ASSOCIATED WITH HURRICAN PASSAGE,

Naval Postgraduate School, Monterey, Calif. Dept. of Oceanography.

# Field 02—WATER CYCLE

# **Group 2B—Precipitation**

Jack James Jenson.

Jack James Jenson. Available from the National Technical Information Service as AD-713 052, \$3.00 in paper copy, \$0.95 in microfiche. MS Thesis, Naval Postgraduate School, Sept 1970. 55 p, 16 fig, 1 tab, 16 ref.

Descriptors: \*Water temperature, \*Gulf of Mexico, \*Hurricanes, Surface waters, Meterological data, Model studies, Computer models, Hydrologic data, Forecasting, Heat transfer, Advection, Convection, Thermal stratification, Oceanography, Data collections.
Identifiers: Ocean-temperature changes (Hur-

ricanes).

Analyses were made of the sea surface temperatures in the Gulf of Mexico for the month of August for the four years 1965 through 1968. No one pat-tern was found to predominate. The subsurface profiles were then considered, and a rate of simu-lated withdrawal of 4000 calories of heat per day was made, until the temperature did not exceed 26 deg C. This withdrawal represented heat removed during passage of a hurricane. Difference analyses were constructed for the initial sea surface temperature at each station after twenty-four hours of simulated withdrawal. The differences ranged from less than one degree to over four degrees. Again, no consistent pattern was found but generally areas of high concentrations of heat experienced smaller decreases. Actual sea surface temperatures collected after two hurricanes were then analyzed and compared to temperature pattern predicted by the computer model. Illustrations of the relative availability of sensible heat energy for different sea surface temperatures are presented and a hypothesis made to account for the greater than average intensities of Hurricanes Betsy (1965) and Camille (1969). (Woodard-USGS) W71-08347

# CLOUD DEVELOPMENT AND DISTRIBUTION AROUND KHARTOUM, Southern Oregon Coll., Ashland. Dept. of Geog-

raphy. R. M. Hammer.

Weather, Vol 25, No 9, p 411-414, Sept 1970. 3 fig, 2 ref.

Descriptors: \*Clouds, \*Rainfall, \*Semiarid climates, \*Climatic data, \*Surface waters, Topography, Vegetation effects, Orography, Radar, Onsite investigations, Evaporation, Edge effect, Environmental effects, Winds, Mode of action. Identifiers: \*Cumulus clouds, \*Cumulonimbus clouds, \*Sudan, \*Cloud distribution.

Mesoscale distributions of cumuliform clouds were mapped in the Khartoum region of the Sudan, and an attempt was made to evaluate cloud distribution in terms of surface features. Visual observations during the rainy seasons (1964-1965) indicated that about 95% of the first cumulus were concentrated in 2 major areas, one to the east and southeast around Khartoum, and the other west of Khartoum. Using radar and visual observation, areal distribution and development of showers was mapped. About 80% developed in the southeast quadrat and 15% slightly west. For various reasons, orographic effects, vegetation, and soil color were ruled out as primary causes of cloud development, while the distribution of water and irrigated surfaces presented a fairly close relationship to the cloud pattern. A possible causative mechanism might be the development of a cool moist dome over the water which in turn might cause an increased convergence of the surface wind along the west side of the dome, resulting in greater low-level cloud development. Perhaps man, through irrigation, has inadvertently enhanced shower development in the region. (Casey-Arizona) W71-08449

#### SPACE-TIME VALIDATION OF A THUN-DERSTORM RAINFALL MODEL,

Arizona Univ., Tucson. Dept. of Watershed Management.

M. M. Fogel, L. Duckstein, and C. C. Kisiel.

Water Resources Bulletin, Vol 7, No 2, p 309-316, Apr 1971. 8 p, 3 fig, 2 tab, 9 ref. OWRR Project A-020 ARIZ (2).

Descriptors: \*Probability, \*Statistical models, \*Rainfall, \*Thunderstorms, \*Illinois, Precipitation (Atmospheric), Frequency analysis, Distribution patterns, Urbanization, Cities, Rainfall-runoff rela-

itionships.
Identifiers: \*Urban water resources, \*Urban hydrology, Chicago (Illinois).

A probability model for predicting the occurrence and magnitude of thunderstorm rainfall developed in the southwestern United States was tested in the metropolitan Chicago area with reasonable success, especially for the moderate to the extreme runoff-producing events. The model requires the estimation of two paramenters, the mean number of events per year and the conditional probability of rain given that an event has occurred. To tie in the rain given that an event has occurred. To tell in the data from more than one gage in an area, an event can be defined in several ways, such as the areal mean rainfall exceeding 0.50 inch and at least one gage receiving more than 1.0 inch. This type of definition allows both of the model parameters to be obtained from daily warm-season rainfall records. Regardless of the definition used a Poisson distribution adequately described the number of distribution adequately described the number of events per season. A negative binomial distribution was derived as representing the frequency density function for rainfall where several gages are employed in defining a storm. Chicago data fit both distributions very well at events with relatively high return periods. The results indicate the possibility of using the model on a regional basis where limited amount of data may be used to estimate parameters for extensive areas. (Knapp-USGS)
W71-08530

# HEAVY RAIN, HAIL, AND TORNADOES ON 15

MAY 1908, Illinois State Water Survey, Urbana. Stanley A. Changnon, and John W. Wilson. Illinois Water Survey Report of Investigation 66, 1971. 48 p, 42 fig, 13 tab, 26 ref.

Descriptors: \*Thunderstorms, \*Illinois, \*Synoptic analysis, \*Tornadoes, \*Cloudbursts, Cyclones, Disasters, Storm runoff, Turbulence, Storm structure, Flooding, Squalls, Weather patterns, Cloud physics, Lightning, Overland flow, Precipitation (Atmospheric), Anticyclones, Atmospheric pressure, Climatic data, Fronts (Atmospheric), Rainfall intensity, Wind velocity, Distribution patterns, Soil

Identifiers: \*McLean County, \*Dewitt County, \*Platt County, Bloomington, Farmer City (Ill).

On 15 May 1968 a severe storm combining heavy rain, tornadoes, and extensive hail occurred and maximized over a 1765-square-mile dense raingage-hailpad and hail observer network in central Illinois. In a 14-hour period the network area had 4 major rain systems which included 19 thunderstorms (rain cells) and point rainfalls exceeding 10 inches, 113 hailstreaks with hail over 1664 square miles, and 6 tornadoes. Crop and property damages were extensive. One rain system was a gigantic steady-state storm that produced excessive rain rates, the tornadoes, and a design hailstreak which lasted 90 minutes with point durations up to 45 minutes, covered 788 square miles, and produced 2-inch hailstones. Rainfall rates for duraproduced 2-incr maistonies. Nathrali rates for durations ranging from 15 minutes up to 6 hours easily exceeded 100-year point frequency values, and at its peak, the steady-state storm released 883 million cubic feet of water in one 15-minute period. Many synoptic weather conditions conducive to severe weather outbreaks existed in central Illinois on 15 May. All four rain systems maximized their rain, hail, and tornado production within a 1765square-mile area. The conditions critical for severe weather formation had not altered their geographical position over a 6-hour period, a situation frequently necessary for the production of 10-inch or greater rainfalls in Illinois. (Glasby-USGS) W71-08917

# 2C. Snow, Ice, and Frost

SOME ASPECTS OF EROSION AND SEDIMEN-

TATION IN AN ARCTIC DELTA DURING BREAKUP,
Louisiana State Univ., Baton Rouge, and Office of Naval Research, London (England).
For primary bibliographic entry see Field 02J.
W71-08344

THE REMOTE SENSING OF THE SEA AND

Naval Research Lab., Washington, D.C. For primary bibliographic entry see Field 07B. W71-08364

METHODS OF CALCULATING SNOW COVER DENSITY IN THE KYZYLCHA MOUNTAIN RIVER BASIN (RUSSIAN: NEKOTORYYE SPOSOBY RASCHETOV PLOTNOSTI SNEZH-NOGO POKROVA V BASSEYNE GORNOY REKI KYZYLCHA),

Yu. B. Sadvakasov, and Ye. M. Kozik. Meteorologiya i Gidrologiya, No 11, p 77-82, Nov 1970. 1 fig, 5 tab, 3 ref.

Descriptors: \*Snow cover, \*Snow surveys, \*River basins, Precipitation (Atmospheric), Air temperature, Meteorological data, Foreign research. Identifiers: \*USSR, Tyan'-Shan' Mountains.

Snow survey data for a six-year period (1960-1965) are used for finding methods to calculate snow cover density. Density of the snow cover is examined as a function of time and as a function of examined as a function of time and as a function of the amount of winter precipitation and air temperature. A comparison of the two methods shows that in 85 and 90% of the cases, respectively, absolute errors do not exceed 0.04 g/cu cm and that root mean-square errors are 0.031 g/cu cm. Additional studies are required to increase the accuracy of computations by accounting for the effect of meteorological factors. (Josefson-USGS) W71-08370

LONG-RANGE FORECAST OF WATER IN-FUNE TO THE KIEV RESERVOIR DURING A
SPRING HIGH-WATER PERIOD (RUSSIAN:
DOLGOSROCHNYY PROGNOZ PRITOKA
VODY ZA PERIOD VESENNEGO POLOVOD'YA K KIYEVSKOMU VODOK-HRANILISHCHU),

For primary bibliographic entry see Field 04A. W71-08375

ACCOUNTING FOR PEAK FLOW DURING A ACCOUNTING FOR PEAK FLOW DURING A
HIGH-WATER PERIOD IN COMPUTATIONS
AND FORECASTS OF A SPRING RUNOFF
MAXIMUM (RUSSIAN: OB UCHETE DRUZHNOSTI RAZVITIYA POLOVOD'YA V
RASCHETAKH I PROGNOZAHK VESENNEGO
MAKSIMUMA),
FOR DIJIMAN MINISTER FIRM OF A PROGRAM MARIEN MINISTER FIRM OF A PROGRAM MARIEN MINISTER FIRM OF A PROGRAM MARIEN MINISTER FIRM MARIEN MINISTER FIRM MARIEN MARIEN

For primary bibliographic entry see Field 04A. W71-08377

RATES OF MELT WATER FLOW ALONG SLOPES (RUSSIAN: O SKOROSTYAKH STEKANIYA TALOY VODY PO SKLONAM), For primary bibliographic entry see Field 04A. W71-08380

THE URBAN SNOW HAZARD: ECONOMIC AND SOCIAL IMPLICATIONS, Illinois Univ., Urbana. Water Resources Center. For primary bibliographic entry see Field 06B. W71-08493

EXPERIENCE WITH THE USE OF TURBOJET INSTALLATIONS IN HYDRAULIC CONSTRUC-

G. F. Biyanov, and L. N. Toropov. Hydrotechnical Construction, No 3, p 217-220, Mar 1970. 4 p, 4 fig, 2 ref.

Descriptors: \*Cold weather construction, Arctic. \*Thawing, Snow, \*Snow removal, Foreign construction, Frozen soils, Construction, Cutoffs, Ice, Foundations, Concrete placing, Soil compaction, Mobile equipment, Cutoff trenches, Rockfill dams. Permafrost, Safety, Foreign design practices. Identifiers: \*Turbojet engines, Viliuisk Dam and Pwrplt (USSR), USSR, \*Ice removal.

High temperature exhaust gases from turbojet engines were used in the USSR for thawing and drying frozen soils during construction at the Viliuisk hydroelectric installation. Turbojet equipment was installed on the left bank of the river near the trench and dam cutoff for thawing 20,000 cu m of frozen loam to be placed in the cutoff and core of the dam. In addition to stationary installations, turbojet engines were mounted on caterpillar or wheeled chassis for removing snow and ice from fills or used in stripping rock foundations in preparation for concrete placement. The experiences encountered at the Viliuisk installation demonstrated that the turbojet equipment can be used successfully for different construction operations on hydraulic construction work in Arctic re-

PHYSICAL PROPERTIES OF ALPINE SNOW AS RELATED TO WEATHER AND AVALANCHE CONDITIONS, Rocky Mountain Forest and Range Experiment

Station, Fort Collins, Colo.

M. Martinelli, Jr.

USDA Forest Serv. Res. Pap RM-64, 35 p, illus.

Descriptors: \*Avalanches, \*Snowpacks, \*Snow, \*Snow cover, Crystals, Climatic data, Weather data, Colorado, Bulk density, Porosity.
Identifiers: \*Alpine, \*Slab avalanches, Physical properties, Snow crystals, Avalanche starting

Data were taken in avalanche starting zones at 11,700 feet in Front Range of Colorado within 14 days of deposition. Densities varied from 40 to 450

kg m-3. A statistical criterion was used to identify snow with unusually high density for its age (initial hard slab) and unusually low (persistent soft snow). Initial hard slab, found in 15 percent of the pits, was correlated with moderate to high windspeeds, low temperatures, and blowing snow. No way was found to distinguish initial hard slab from dense older snow. Tensile strength varied from 1.0 to 1712 grams force cm-2. Strength increased with density but varied greatly. Younger snows were weaker than older snows of same density. Strength was also measured with shear box and shear vane. Ram resistance was higher for alpine snow than for snow of same density in trees. Air permeability was an order of magnitude less than expected and varied with low flow rate used. The ratio virtual porosity/porosity, which averaged 1.062, was of little value for identifying wind slab. Strength of snow of given density was greater for a certain permeability (texture) than for any other.
W71-08840

AREAL SNOW COVER AND DISPOSITION OF CENTRAL SNOWMELT RUNOFF COLORADO,

Rocky Mountain Forest and Range Experiment For primary bibliographic entry see Field 03B. W71-08844 Station, Fort Collins, Colo.

MEASURING ILLUMINATION WITHIN SNOW COVER WITH CADMIUM SULFIDE PHOTO RESISTORS,
Rocky Mountain Forest and Range Experiment

Station, Fort Collins, Colo.

For primary bibliographic entry see Field 02D. W71-08849

TERRAIN AND COVER EFFECTS ON SNOW. MELT IN A WESTERN WHITE PINE FOREST. Intermountain Forest and Range Exp Station,

For primary bibliographic entry see Field 04C. W71-08854

BIBLIOGRAPHY ON NORTHERN SEA ICE

AND RELATED SUBJECTS,
Canada Ministry of Transport, Ottawa (Ontario).
Marine Operations; and Department of Energy,
Mines and Resources, Ottawa (Ontario). Marine Sciences Branch.

J. D. Bradford, and S. M. Smirle.

Canada Ministry of Transport and Dept of Energy, Mines and Resources Cooperative Bibliographic Report, Jan 1970. 188 p.

Descriptors: \*Bibliographies, \*Publications, \*Information retrieval, \*Sea ice, \*Navigation, Icebergs, Oceans, Documentation, Ships, Libraries. Identifiers: \*Northern sea ice.

This bibliography confines the references cited to subjects which have a bearing on the operation of ships in ice. While geographically the emphasis is Canadian, works which describe foreign experience in northern sea ice research and technology are included. References to literature on ice islands, ice shelves and icebergs are only included if information on sea ice movement is provided. Initially, the references were gathered from recent sea ice literature. To these were added the relevant holdings of the following libraries: Department of Transport; National Science Surveys and Mapping Branch, Department of Energy, Mines and Resources; Water Sector, Department of Energy, Mines and Resources; Defence Research Board (Geophysics); Arctic Institute of North America; Stefansson Collection, Dartmouth College, U.S. Army, Cold Regions Research and Engineering Laboratory; and Massachusetts Institute of Technology. (Woodard-USGS) W71-08920

# 2D. Evaporation and Transpiration

THE EFFECTS OF ANTITRANSPIRANT CHEMICALS ON THE TRANSPIRATION AND PHYSIOLOGY OF TAMARIX SPECIES,

Arizona Univ., Tucson. Dept. of Watershed

Management.

Kenneth Norman Brooks.

Arizona University, PhD Dissertation, 1970. 84 p, 17 fig, 20 tab, 75 ref. OWRR Project A-018-ALA

Descriptors: \*Phreatophytes, \*Tamarisk, \*Stomata, \*Water conservation, \*Chemcontrol, Laboratory tests, Environmental effects, Plant physiology, Mode of action, Transpiration, Leaves, Photosynthesis, Respiration, Arid lands, Plant growth, Temperature, Foliar application. Identifiers: \*Antitranspirants, \*Leak temperatures.

In the water-short southwest, certain phreatophyte species have been highly controversial. Because these plants exploit the water table and have high transpiration rates, expensive eradication programs have often been employed. However these have been opposed for esthetic and wildlife conservation reasons. If suitable antitranspirants were developed, perhaps water use could be decreased without plant destruction. Using tamarisk (Tamarix pentandra Pall.) and athel tree (T. aphylla L.), several antitranspirants were subjected to greenhouse study and the potentially effective compounds given further detailed study. Spray applications of 0.01 M 8-hydroxyquinoline sulfate and a combination of 150 ppm mono-methyl and 150 ppm mono-glyceryl esters of N-decenylsuccinic acid in Triton X-100 solutions reduced daily transpiration rates 28-36% for 20 days. Both applications reduced tamarisk stomatal apertures significantly, and reduced growth rates for 10-20 days. The decreased growth rates may have caused the

reduced transpiration rates. Foliage analyses showed no effect on chlorophyll and protein contents. Transpiration rates of potted field tamarisks were reduced for only 5 days, but this may have been affected by rainfall on the fifth day. The data indicates that tamarisk transpiration may be substantially reduced by antitranspirants through growth reduction without lethal increases in foliage temperature. (Casey-Arizona) W71-08469

THE ENERGY BUDGET OF MAN AT HIGH AL-TITUDES,
California Univ., Los Angeles, Dept. of Geography,

W. H. Terjung.
International Journal of Biometeorology, Vol 14, No 1, p 13-43, 1970. 30 fig, 19 ref.

Descriptors: \*Arid lands, \*Mountains, \*Solar radiation, \*Energy budget, \*Model studies, Environmental effects, On-site investigations, Climatic data, Altitude, Estimating equations, Seasonal, Diurnal, Air temperature, Albedo, Air masses, Snow cover, Climatic zones, California, Evaporation, Correlation analysis, Convection. Identifiers: \*Radiation climatology, \*Optical airmass \*Sweating

The greatest solar radiation intensities on this planet may occur during the summer in arid region high mountain ranges of the lower middle latitudes, high mountain ranges of the lower middle latitudes, such as the White Mountain Range of California. Attempts were made to link the physical energy balance climatology of the area to the human energy balance climatology along an altitudinal transect. Energy balance equations relating radiation to evaporation, sensible heat flux and soil heat flux are developed for physical-horizontal surfaces and human surfaces. The direct beam solar radiation on a horizontal surface could be roughly described by an exponential function of elevation that varied with time while the radiative lapse was that varied with time while the radiative lapse was an approximate negative exponential function of the sun zenith angle. A plot of the ratio of direct beam (or diffuse) solar radiation to available energy on top of the atmosphere vs. optical airmass showed a good-fitting linear relationship, creating a highly predictive method for deducing the midsummer radiation climatology of the area. Air temperature proved a poor measure of the conditions affecting man. The human net radiation pattern was inverse to the diurnal radiation pattern for the horizontal-physical surface. The data was used to test 2 variations of a model predicting human net radiation at high elevations: a summer model and a simulation model for the whole year. The predictive abilities for both models were high and their construction yielded several insights. Vertical man probably receives more than half of the reflected diffuse solar radiation and the relatively high amounts of human net radiation could be drastiamounts of human net radiation could be drasti-cally reduced by stepping under a tree. At the peak of human net radiation, evaporation (sweating) was activated to share the burden of heat disposal with the sensible heat fluxes. (Casey-Arizona) W71-08473

A NIGHTTIME ENERGY AND MOISTURE BUDGET IN DEATH VALLEY, CALIFORNIA,

IN MID-AUGUST,
California Univ., Los Angeles. Dept. of Geography.
Werner H. Terjung, Simon O. Ojo, and Stanley W.

Geografiska Annaler, Vol 52A, No 3-4, p 160-173, 1970. 17 fig, 1 tab, 26 ref.

Descriptors: \*Deserts, \*Energy budget, \*Solar radiation, \*Evaporation, \*Climatic data, Environmental effects, Advection, Ecosystems, Air temperature, Soil temperature, Albedo, Dew, Convection, Conduction, Infrared radiation, Wind velocity, Model studies, Estimating equations, On-site investigations, Vapor pressure, Diurnal dis-

Identifiers: \*Mojave Desert, \*Death Valley, \*Moisture budget, \*Net radiation, \*Bowen ratio, Identifiers: Radiation efficiency.

tribution

# Field 02-WATER CYCLE

# Group 2D—Evaporation and Transpiration

Basic observational data on the diurnal regime of radiation budgets and their observed phenomena were obtained over 20 hr. of a hazy August day in Death Valley. The basic energy budget equations are developed, their physical components described, and measurement techniques reviewed. Total environmental radiant temperature (Tsube) is more important in determining organism heat gain or loss than the popularly used air tempera-ture. Tsube is one-half the sum of bare soil and sky temperatures. Desert vegetation surface tempera-tures, compared with bare surface temperatures, tures, compared with bare surface temperatures, were lower during the day and higher at night. Soil temperatures were considerably higher during the night than actual surface temperature. During the night, steady infrared radiation loss resulted in a negative net radiation ratio (-0.13 ly/min) and the resulting energy budget deficit was satisfied by heat flux out of the ground. Little nighttime evaporation occurred except when high wind speeds created adoccurred except when high wind speeds created advective effects interrupting dew deposition. A theoretical net radiation model developed by Sellers and Budyko was tested against the observed data and excellent agreement was found. Parts of the model were expanded and again agreed well with observations. Net radiation and other energy budget data could therefore have been obtained from meteorological data commonly available at major weather stations (Casey-Ariyona) major weather stations. (Casey-Arizona) W71-08480

SOME PHYSICAL ASPECTS OF WATER RESOURCE DEVELOPMENT IN TANZANIA, University Coll., Dar-es-Salaam (Tanzania). Dept. of Geography. Ian J. Jackson.

Geografiska Annaler, Vol 52A, No 3-4, p 174-185, 1970. 5 fig, 10 tab, 40 ref.

Descriptors: \*Rainfall, \*Evapotranspiration, \*Climatic data, \*Water resources development, \*Water requirements, Crops, Research and development, Hydrological cycle, Rainfall disposition, Data collections, Land use, Variability, Semiarid climates, Stemflow, Sediment yield, Streamflow, Forests, Runoff, Vegetation. Identifiers: \*East Africa, \*Tanzania, \*Potential evapotranspiration evapotranspiration.

Tanzania is mainly an agricultural country with limited water resources and seasonal rainfalls. Climatic zones range from the coastal humid areas to large semiarid regions. The relief and annual re-gional rainfalls of the country are described. Rain-fall variability has a drastic effect on agriculture and only half the country has a threshold 750 mm rainfall per year with 80% probability. The Penman method of determining potential evapotranspiration has proved to be the most accurate. Despite uncertainties it appears that evaporation rates are high in relation to rainfall. Spatial and temporal variations of rainfall are analyzed. Particularly im-portant are the evaporative demand/crop water requirement ratios in differing regions for differing crops. A number of experiments in catchment areas on land use impact have yielded important results. Dense forests are excellent catchment areas, and the replacement of bamboo by softwood does not produce permanent effects on runoff or sediment yield, while replacement of high forests by tea plantations may increase runoff by 15%. Soil erosion becomes a serious problem in cultivated catchments and must be balanced against water loss by tree transpiration. An overgrazed region with more than 750 mm/yr rainfall may have vegetation characteristic of arid regions. Much data is urgently needed and promising research projects are outlined. (Casey-Arizona) W71-08483

RELATES RESEARCH WEATHER TO NEBRASKA WATER USE,

Nebraska Univ., Lincoln. Dept. of Horticulture and

Norman J. Rosenberg.
Nebraska Farm, Ranch and Home Quarterly, Vol 16, No 2, Summer 1969, p 25-28. 2 tab, 3 fig.

Descriptors: \*Transpiration, \*Evapotranspiration, \*Lysimeters, \*Instrumentation, \*Soil-water-plant relationships, Weather, Nebraska, Evaporation, Great Plains, Water vapor, Water transfer, Energy budget, Sprinkler irrigation, Flood irrigation, Meteorology, Experimental farms, Solar radiation, Soil temperature, Wind velocity, Humidity, Elevation, Soil properties, Water demand, Consumptive use, Atmospheric physics, Alfalfa, Crop production, Windbreaks, Evaporation control. Identifiers: Net radiation, Soil heat flux, Data loggers.

Research is described which relates weather conditions to evaporation and plant water use in the Great Plains of eastern Nebraska. Basic principles Great Plains of eastern Nebraska. Basic principles of evaporation, evapotranspiration, lysimeters, water vapor transfer, and energy budgets are discussed. Energy budgets for eastern and western states are contrasted according to evapotranspiration regimes. Precision weighing lysimeters were installed on a sprinkler and flood-irrigated 5-acre plot at the University of Nebraska Field Laboratory at Mead in 1966. Water evaporated in a 15-minute period can be accurately measured. Meteorological period can be accurately measured. Meteorological instruments at the site measure solar and net radiation, soil heat flux, wind speed and direction, tem-perature and humidity at various elevations, and perature and humidity at various elevations, and soil and plant temperatures. Instrumentation is linked together by data loggers, which are computer compatible. Quality checking and analysis generates important data on radiation balance and heat transport. A computer plotter graphs functional relationships between measured parameters. The water demand of consumpting access and The water demand of consumptive crops and atmospheric processes are studied. Evapotranspiration is highest in the late spring and early summer because of hot winds. Evaporation is highest in the daytime, and continues at night as soils release energy. These studies will be useful for optimum water use on alfalfa and other crops. Other experiments on water use efficiency, anti-transpirant chemicals, reflectant materials, and windbreaks will be conducted. Figures and tables show a precision lysimeter, meteorological sensors, data loggers, and energy balance and nocturnal evapotrans-piration data sheet. (Popkin-Arizona) W71-08490

MEASURING ILLUMINATION WITHIN SNOW COVER WITH CADMIUM SULFIDE PHOTO RESISTORS,

Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo. James D. Bergen.

USDA Forest Serv Res Note RM-181. 4 p.

Descriptors: \*Snow, \*Solar radiation, \*Snowpacks, \*\*Photometry, Colorado, Snow cover, Light intensity, Solar radiation.

Identifiers: \*Photo resistors, \*Cadmium sulfide, Light attenuation, Turbidimetry.

Light-sensitive cadmium sulfide resistors can measure the downward flux of sunlight in the snow cover. When the variation of sensor response and the absorptivity of ice are considered together with the approximate distribution of energy in the solar spectrum, the variation of cell resistance (R) is estimated by 4.55/RE.925 — 2.1 X.925 .. X3.27 where (E is the total incident radiation at the snow surface and (X) is the average attenuation ratio for radiation between 0.5 microns and 0.7 microns. The last term becomes negligible for values of XAO.3. W71-08849

ESTIMATING EVAPOTRANSPIRATION - AN EVALUATION OF TECHNIQUES.

Australian Water Resources Council, Canberra.

Australian Water Resources Council Hydrological Series No 5, 1970. 23 p, 49 ref.

Descriptors: \*Evaporation, \*Energy budget, \*Evapotranspiration, \*Analytical techniques, Estimating, Evaluation, Data collections, Lysimeters, Equations, Instrumentation, Costs, Water balance, Advection.

Identifiers: \*Australia.

Several Australian techniques for measuring evaporation from natural surfaces are described. The three main techniques involve determinations of (1) the evaporation term in the water balance, (2) the latent heat term in the energy balance, and (3) the net upward flow of water vapor in the air layers near the gound. In addition, methods developed involving combinations of (2) and (3) and a number of procedures developed for empiri-cally calculating E from measured meteorological variables are discussed. At present the method suitable for the measurement of evaporation, from most types of land surfaces, appears to be that-based on the evaluation of the surface energy balance. (Woodard-USGS) W71-08930

#### 2E. Streamflow and Runoff

FLOODS IN WILMINGTON QUADRANGLE, NORTHEASTERN ILLINOIS, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 07C. W71-08332

FLOODS IN HUNTLEY QUADRANGLE, NORTHEASTERN ILLINOIS, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 07C. W71-08334

HEBRON QUADRANGLE, FLOODS IN NORTHEASTERN ILLINOIS, Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C. w7 i-08335

FLOODS IN VICINITY OF ELLIJAY, GEOR-

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 07C. W71-08336

FLOODS IN THE YABUCOA AREA, PUERTO

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 07C. W71-08337

NORTHEASTERN ILLINOIS, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 07C. W71-08338 FLOODS IN CHANNAHON QUADRANGLE

APPLICATION OF AERIAL PHOTOIN-TERPRETATION METHODS IN HYDROLOGI-CAL STUDIES WITH SPECIAL REFERENCE TO THE PROBLEMS IN EASTERN INDIA, Geological Survey of India, Calcutta. For primary bibliographic entry see Field 07B. W71-08341 AERIAL

WATER RESOURCES OF EAST BIHAR RIVERS,

Bihar State Irrigation Commission, Patna (India). A. Das Gupta, and S. D. N. Verma. Indian Geohydrology, Vol 5, No 1, p 50-57, Dec 1969. 8 p, 1 fig, 5 tab.

Descriptors: \*Water resources development, \*River basin development, \*Data collections, Hydrologic data, Runoff, Streamflow, Dams, Watershed management, Reservoirs, Water supply, Streamflow forecasting Identifiers: Bihar (India).

Water resources of East Bihar (India) rivers have largely remained untapped. Except for the Mayu-

## Streamflow and Runoff-Group 2E

rakshi, Badua and Chandan reservoir projects, no other major projects have been built so far in East Bihar. Assessment of water resources of the Ajoy, Gumani, Chandan, Badua and Chir rivers was made with the available rainfall and discharge data. The relationship between historical runoff and effective rainfall was derived for these river basins. Percentage availability of runoff was determined, and the water potential of the basins for irrigation was worked out and presented in tables. (Knapp-USGS)
W71-08342

DRAINAGE PATTERN ANALYSIS, SOUTHERN HIGH PLAINS, WEST TEXAS AND EASTERN NEW MEXICO.

Texas Technological Coll. Lubbock. Dept. of Geosciences.

For primary bibliographic entry see Field 02F.

UPWELLING, COLUMBIA RIVER PLUME AND ALBACORE TUNA,
Oregon State Univ., Corvallis. Dept. of Oceanog-

For primary bibliographic entry see Field 07B. W71-08358

INFRARED EXPLORATION FOR SHORELINE SPRINGS AT MONO LAKE, CALIFORNIA, TEST SITE,

Colorado School of Mines, Golden. Dept. of Geology.

For primary bibliographic entry see Field 07B.

TIME-SPACE VARIATIONS OF THE GULF STREAM AS OBSERVED BY AIRBORNE REMOTE SENSING TECHNIQUES, Naval Oceanographic Office, Washington, D.C. For primary bibliographic entry see Field 07B.

W71-08366

CALCULATION OF FLOWS DURING SUDDEN FLOW EXPANSION (RUSSIAN: RASCHET TECHENIY PRI VNEZAPNOM RASSHIRENII POTOKA).

Leningradskii Institut Inzhenerov Vodnogo Transporta Moscow (USSR).

For primary bibliographic entry see Field 08B.

**CONSIDERATION OF LOSSES IN COMPUTING** A SPRING HIGH-WATER HYDROGRAPH (RUSSIAN: UCHET DINAMIKI POTER'PRI RASCHETE GIDROGRAFA VESENNEGO POLOVOD'YA), V. I. Koren, and V. A. Bel'chikov.

Meteorologiya i Gidrologiya, No 11, p 65-69, Nov 1970. 1 fig, 8 ref.

Descriptors: \*Hydrographs, \*Model studies, Infiltration, Soil moisture, River basins, Freezing, Runoff, Precipitation (Atmospheric), Frozen soils. Identifiers: \*USSR, Ice crust.

Computation of a spring high-water hydrograph is a successive calculation of water inflow, water loss and the movement of water along slopes and channels. To select a model for computing water infiltration the following factors are considered: (1) the relationship between losses and soil moisture and freezing depth; (2) the constancy of loss with increased soil moisture and freezing depth; (3) the reduced infiltration rate at end of snow melt; and (4) the effect of an ice crust on the character of infiltration. Two small rivers--the Seym and Oka--are used to test the model. Five flood periods are selected for each basin for obtaining optimal parameters. Except for ice crust and basin wetness the parameter values derived from optimization are quite close for the two basins. (Josefson-USGS) W71-08372

MATHEMATICAL MODELS OF STREAM-FLOW TRANSFORMATION AND METHODS OF DETERMINING THEIR PARAMETERS (RUSSIAN: MATEMATICHESKIYE MODELI PROTESSA TRANSFORMATSII RECHNOGO STOKA I METODY OPREDELENIYA IKH PARAMETROV),
Yu. M. Denisov, and I. D. Shentsis.
Meteorologiya i Gidrologiya, No 11, p 58-64, Nov 1970. 2 fig, 4 tab, 4 ref.

Descriptors: \*Mathematical models, \*Streamflow, \*River basins, \*Input-output analysis, Least squares method, Foreign research, Melt water, Rain water, Discharge (Water), Aquifers, Runoff. Identifiers: \*USSR, Akhangaran River, Mountain

A river basin is viewed as a dynamic system whose input is the flow of snowmelt and rain water onto a basin surface and whose output is the discharge of water at the outlet. In view of differences in the conditions and character of water movement on surfaces and in variously located aquifer horizons, a mountain basin is presented in the form of several reservoirs (layers) located one under the other and connected in series-parallel mode. It is assumed that water moves out of reservoirs into underlying reservoirs as well as from each reservoir into the outlet. Two methods are used to find optimal parameter values for mathematical models of streamflow transformation by a mountain basinthe least squares method and a combination method involving a one-volume nonlinear and a two-volume linear model. The combination method is preferred in determining model parameters for the Akhangaran River for the period 1957-1963. (Josefson-USGS) W71-08373

PROBLEMS OF HYDROLOGIC FORECASTS AND COMPUTATIONS (RUSSIAN: VOPROSY GIDROLOGICHESKIKH PROGNOZOV I RASCHETOV),

For primary bibliographic entry see Field 04A. W71-08374

POSSIBILITIES OF FORECASTING DNIESTER RIVER SPRING RUNOFF (RUSSIAN: VESENNIY STOK DNESTRA I VOZMOZHNOST' YEGO PROGNOZA).

A. V. Shcherbak.

In: Voprosy gidrologicheskikh prognozov i raschetov, Ukrainskiy Nauchno-Issledovatel' skiy Gidrometeorologicheskiy Institut Trudy, No 76, p 43-55, 1969. 4 fig, 5 tab, 14 ref.

Descriptors: \*Runoff forecasting, \*Snowmelt, \*Rainfall-runoff relationships, \*Discharge (Water), Melt water, Air temperature, Seasonal, Precipitation (Atmospheric), Climatic data, Tributaries, River forecasting, Surface-groundwater rela-

Identifiers: \*Ukraine, Dniester River, Snow storage, Spring runoff.

An analysis was made of the formation conditions of spring runoff in the Dniester basin for determining the possibility of preparing forecasts. The spring runoff used was that formed mainly by the melting of snow after air temperature had finally risen above the 0 deg C mark. Spring runoff from the Dniester River was separated into its component parts according to recharge. The meltwater component in the total Dniester spring runoff was 54% and the groundwater and rain component vas 54% and the groundwater and rain component 22 and 24%, respectively. A major role in the formation of Dniester spring runoff was assumed by Carpathian river tributaries, with little participation by the left bank of the basin, which covered 66% of the basin area. A relationship was established between Dniester spring runoff and snow storage by time of snowmelt and precipitation during the high-water period. The computed value during the high-water period. The computed value of snow storage and precipitation in the basin was determined by their participation in total spring ru-noff. It was also established that fall wetting in the Dniester basin had no appreciable effect on the

magnitude of spring runoff. Use of the relationship obtained was complicated by the impossibility of arriving at an accurate estimate of the precipitation which would occur during a runoff formation period. It is suggested that a forecast of maximum spring inflow for the Dniester be prepared and then refined on the basis of the actual amount of precipitation after start of spring runoff. (See also W71-08374) (Josefson-USGS) W71-08379

OPTIMAL LENGTH OF REACH AND TIME INTERVAL IN COMPUTATIONS OF UNSTEADY MOVEMENT OF WATER USING THE METHOD OF G. P. KALININ AND P. I. MILYU-KOV (RUSSIAN: OPTIMAL'NYYE DLINA UCHASTKA I INTERVAL VREMENI PRI RASCHETAKH NEUSTANOVIVSHEGOSYA NEUSTANOVIVSHEGOSYA
DVIZHENIYA VODY PO METODU G. P.
KALININA I P. I. MILYUKOVA),
For primary bibliographic entry see Field 04A.

W71-08390

NUMERICAL SIMULATION OF WATERSHED HYDROLOGY,

Texas Univ., Austin. Dept. of Civil Engineering. For primary bibliographic entry see Field 02A. W71-08392

FLOODS OF SEPTEMBER 1970 IN ARIZONA, UTAH, AND COLORADO,

Geological Survey, Phoenix, Ariz.

R. H. Roeske.

Arizona Land Department Water Resources Report, No 44, Apr 1971. 20 p, 1 tab.

Descriptors: \*Floods, \*Flood damage, \*Arizona, \*Utah, \*Colorado, Rainfall, Runoff, Streamflow, Stream gages, Hydrologic data, Data collections, Flow rates, Discharge measurement, Peak discharge, Flood plains, Meteorological data. Identifiers: \*Arizona floods (1970).

Record floods occurred in Arizona, southeastern Utah, and southwestern Colorado on September 4-7, 1970. The floods took the lives of 25 persons and caused millions of dollars in property damage. The heaviest rainfall occurred in the mountainous areas of central Arizona. Numerous precipitation stations recorded 5 to 8 inches of rainfall in 24 hours, and one station recorded 11.40 inches, which is an alltime record for 24-hour precipitation in Arizona. Two separate peaks of nearly equal stage occurred at Tonto Creek above Gun Creek near Roosevelt. The discharge at the higher stage was 53,000 cfs, which is the highest discharge recorded since the station was established in 1940. The records from two old staff gages at downstream sites indicate this might be the highest peak since the early 1900's. All flow from Tonto Creek was stored in the Salt River reservoirs. A similar storm, but of lesser magnitude, struck southeastern Utah and southwestern Colorado September 12-14, 1970. The largest total 3-day precipitation reported for this storm was 4.83 inches, and the largest 24-hour total reported was 2.84 inches. (Woodard-USGS) W71-08519

THE ACOUSTIC STREAMFLOW-MEASURING SYSTEM ON THE COLUMBIA RIVER AT THE DALLES, OREGON,

Geological Survey, Portland, Oreg. For primary bibliographic entry see Field 07B. W71-08522

WATER DATA -- ATLANTIC SURFACE PROVINCES, 1968.

Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch. For primary bibliographic entry see Field 07C. W71-08524

# Field 02-WATER CYCLE

# Group 2E—Streamflow and Runoff

# OPEN-CHANNEL INTEGRATING-TYPE FLOW

Geological Survey, Albuquerque, N. Mex. For primary bibliographic entry see Field 07B. W71-08525

# GEOLOGICAL SURVEY RESEARCH 1970,

Geological Survey, Washington, D.C.

For sale by the Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price \$4.00. Geological Survey Professional Paper 700-A, 1970. 426 p, 10 fig.

Descriptors: \*Bibliographies, \*Reviews, \*Water resources, Hydrogeology, Mineralogy, Geology, Projects, Resource development, Research and development, Water resources development, Groundwater, Surface waters, Water quality. Identifiers: \*U.S. Geological Survey, \*Water resources research.

'Geological Survey Research 1970,' the eleventh annual review of the economic and scientific work of the U.S. Geological Survey, consists of four chapters (A through D) of Professional Paper 700. Chapter A summarizes significant results, and the remaining chapters consist of collections of short technical papers. The purpose of the volume is to make available promptly to the public many of the highlights of Survey research and investigations.
USGS reports are listed in 'Publications in Fiscal Year 1970'. If a summary statement is the result of collaboration with a colleague from outside the Survey, the colleague's current organization (such as a university) is indicated in parentheses immediately following his name in the text. (Knapp-USGS) W71-08532

# WATER RESOURCES OF THE RIVER ROUGE BASIN, SOUTHEASTERN MICHIGAN, Geological Survey, Washington, DC.

For primary bibliographic entry see Field 07C. W71-08535

# FLOODS IN THE ANASCO AREA, PUERTO

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 07C. W71-08536

#### DEVELOPMENT OF WATER RESOURCES IN THE KHMER REPUBLIC.

Economic Commission for Asia and the Far East. New York.

For primary bibliographic entry see Field 04A. W71-08546

OBSERVATIONS OF THE EFFECT OF EX-TREME HIGH WATER IN 1965 AND 1966 ON THE GROUNDWATER BODY OF THE LIENZ BASIN-EAST TIROL (GERMAN: BEOBACHTUNGEN UBER DIE AUSWIRKUNG DER EXTREMEN HOCHWASSER 1965 UND 1966 AUF DEN GRUNDWASSERKORPER IM BECKEN VON LIENZ (OSTTIROL), For primary bibliographic entry see Field 02A. W71-08580 **BASIN-EAST** TIROL

# HYDROLOGIC DATA UTILIZATION IN FORECASTING THE SPRING 1969 MIDWEST

SNOWMELT FLOODS, Environmental Science Services Administration, Kansas City, Mo., Weather Bureau River Forecast Center.

Herman F. Mondschein.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 468-481, 1970, 14 p, 5 fig, 2 tab, 11 ref. Descriptors: \*Flood forecasting, \*Snowmelt, \*Rainfall-runoff relationships, \*Data processing, \*Warning systems, Mississippi River Basin, Digital computers, Monitoring, Snowpacks, Flood damage, Runoff, Floods. Identifiers: \*Midwestern U.S.

The causes of the 1969 upper Midwest spring floods began in October 1968, when rainfall two and three times normal soaked several states in the area. In mid-December snows occurred at frequent intervals and before Christmas more than 2 feet intervals and before Christmas more than 2 feet was reported at several locations from Kansas to Minnesota. Succeeding months brought additional snow and freezing rain, further increasing the amount of stored water in the snowpack. In spring, snowmelt was rapid, and flooding was severe, widespread, disastrous and of record breaking proportions in a number of widely separated localities. from southern Nebraska to westcentral Minnesota. trom southern Nebraska to westcentral Minnesota. This paper describes the treatment of hydrologic and meteorologic data in the preparation of river stage and flood forecasts by the Kansas City River Forecast Center of ESSA Weather Bureau, both prior to and during this flood. The application of digital computer technology to this problem is emphasized. (See also W71-08550) (Knapp-USGS) W71-08893

# ANNUAL COMPILATION AND ANALYSIS OF HYDROLOGIC DATA FOR ESCONDIDO CREEK, SAN ANTONIO RIVER BASIN, TEXAS-

Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 07C.
W71-08903

#### EDDY FORMATION BEHIND CIRCULAR CYLINDERS.

California Univ., Berkeley. Dept. of Mechanical Engineering Alan D. Laird.

Partially supported by National Science Foundation. ASCE Proceedings, Journal of the Hydraulics Division, Vol 97, No HY6, Paper 8170, p 763-775, June 1971. 13 p, 4 fig, 1 tab, 24 ref, append.

Descriptors: \*Turbulent flow, \*Eddies, \*Vortices, \*Flow around objects, Hydraulics, Hydraulic structures, Piers, Hydraulic models, Hydrodynamics. Identifiers: \*Flow around cylinders.

Eddies formed in the wake of a cylinder in cross flow are explained. Potential flow theory is used to demonstrate basic tendencies resulting from the behavior of shear layers and vortices under a variety of conditions prevailing in actual flows. Eddies are shed alternately behind a cylinder and form Karman vortex streets, as a combination of vorticity emanating from the boundary layers and the instability of these layers due to their vorticity. Potential flow theory gives useful predictions of flow about bluff cylinders. Shear layers are readily disintegrated by flow disturbances. The effects of vorticity in boundary layers on other regions ap parently can be approximated by the effects of disturbed finite vortices in the potential theory modelling of flow about cylinders. (Knapp-USGS) W71-08910

#### PLAIN **INFORMATION-WEST** BRANCH BRANDYWINE CREEK. Corps of Engineers, Philadelphia, Pa.

For primary bibliographic entry see Field 04A. W71-08911

# ON THE SPECTRUM OF SEA LEVEL AT

National Inst. of Oceanography, Wormley (England); and Cambridge Univ. (England). Dept. of Applied Mathematics.

M. S. Longuet-Higgins. Journal of Geophysical Research, Vol 76, No 15, p 3517-3522, May 20, 1971. 6 p, 3 fig, 16 ref. NSF Grant GA-1452. Descriptors: \*Tides, \*Water level fluctuations, \*Hawaii, Tidal effects, Frequency analysis, Statistical methods, Fourier analysis.

The cospectrum of sea level at Honolulu and Mokuoloe has noticeable peaks at frequencies of 0.73, 0.50, 0.35, and 0.25 c/d (cycles per day). Some possible causes are discussed. The broad band near 0.73 c/d may be the local manifestation of inertial, or near-inertial currents generated by winds in the vicinity of Oahu. Because of its frequency and phase, the peak at 0.50 c/d is not a free mode of the Pacific. Most probably it represents topographic Rossby wave trapped by local topography round the island. Though it may be coupled subharmonically to the tides, it is most likely generated by local wind-stresses. The peaks at 0.35 and 0.23 c/d may represent the lowest modes of the Pacific Ocean basin. But these motions may also be due to local weather, in resonance with trapped oscillations. (Knapp-USGS) W71-08912 W71-08912

## MIXING IN THE SURF ZONE,

Scripps Institution of Oceanography, La Jolla,

D. L. Inman, R. J. Tait, and C. E. Nordstrom. Journal of Geophysical Research, Vol 76, No 15, p 3493-3514, May 20, 1971. 22 p, 12 fig, 5 tab, 26

Descriptors: \*Waves (Water), \*Surf, \*Mixing, \*Tracers, \*Dye releases, Turbulence, Ocean waves, Ocean currents, Littoral drift, Advection, Turbulent flow

Identifiers: Longshore currents.

Two important mixing mechanisms are operative within the surf zone, each having distinctive length and time scales determined by the intensity of the waves and the dimensions of the surf zone. The first waves and the dimensions of the surf zone. The first is associated with the breaking wave and its bore, which produce rapid mixing in an on-offshore direction. This mixing, when normalized and averaged over the surf zone width, gives coefficients of eddy diffusivity. The second process is advective and is associated with the longshore and rip current systems in the nearshore circulation cell. For constant longshore discharge of water between cells, this process gives a concentration down-current from a continuously injected source of dye. As an approximation, the concentration decreases exponentially with distance from the injection point. This relation gives an apparent longshore eddy mixing coefficient proportional to the longshore current velocity. W71-08914

# ANNUAL COMPILATION AND ANALYSIS OF HYDROLOGIC DATA FOR GREEN CREEK, BRAZOS RIVER BASIN, TEXAS-1969,

Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 07C.
W71-08918

# FLOOD CONTROL STUDY OF RIO GRANDE DE MANATI, MANATI AND BARCELONETA, PUERTO RICO.

Flavio Acaron and Associates, San Juan (Puerto Rico).

For primary bibliographic entry see Field 04A. W71-08919

# CATALOG OF INFORMATION ON WATER DATA, EDITION 1970 - INDEX TO AREAL INVESTIGATIONS AND MISCELLANEOUS WATER DATA ACTIVITIES. Geological Survey, Washington, D. C. Office of Water Data Coordination.

For primary bibliographic entry see Field 07C. W71-08922

RECONNAISSANCE OF THE BLACK RIVER, A COLD-WATER RIVER IN THE NORTH-CEN-

## Groundwater-Group 2F

TRAL PART OF MICHIGAN'S SOUTHERN PENINSULA.

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 07C. W71-08925

RECONNAISSANCE OF THE STURGEON RIVER, A COLD-WATER RIVER IN THE NORTH-CENTRAL PART OF MICHIGAN'S SOUTHERN PENINSULA, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 07C. W71-08926

HYDROLOGIC DATA: 1968, VOLUME 4, SAN JOAQUIN VALLEY.
California State Dept. of Water Resources, Sacra-

For primary bibliographic entry see Field 07C. W71-08927

A PROPOSED STREAMFLOW DATA PRO-GRAM FOR NORTH CAROLINA, Geological Survey, Raleigh, N.C. For primary bibliographic entry see Field 07A. W71-08932

WATER RESOURCES OF THE BIG CREEK DRAINAGE BASIN,

Ontario Water Resources Commission, Torento

Ontario Water Resources Commission, Torento (Ontario). Div. of Water Resources.
T.J. Yakutchik, and W. Lammers.
Ontario Water Resources Commission, Water Resources Report 2, 1970. 172 p, 56 fig, 8 map, 39

Descriptors: \*Water resources development, \*Streamflow, \*Groundwater, \*Water utilization, Water quality, Irrigation water, Water balance, Water management (Applied), Data collections, Hydrologic data, Hydrogeology. Identifiers: \*Ontario (Canada), Big Creek Basin

Groundwater and surface water resources of the Big Creek Basin, Ontario, were evaluated in terms of quantity, quality, occurrence and use. The various hydrologic parameters were examined and a hydrologic budget is presented. Precipitation averages about 37 inches per year and is generally adequate. During extended dry periods in the summer, irrigation is practiced to overcome moisture deficiencies. Groundwater supplies are abundant in the sand deposits that cover a large part of the basin. Other supplies are also available at depth in the overburden and in the upper part of the bedrock. Groundwater runoff was calculated to amount to about seven inches annually and maintains stable base flows in the streams. The water is generally of good quality and is used extensively for domestic and irrigation purposes. Surface-water supplies are generally abundant except during the supplies are generally abundant except during the irrigation period. During this period extensive withdrawals of water scriously deplete the streamflow; as much as 70 per cent on maximum days. Annual runoff ranged from 6.8 to 14.7 inches during the strength of the stren ing the below-normal precipitation period from October 1962 to September 1967. (Knapp-USGS) W71-08935

DES MOINES RIVER FLOOD PLAIN INFOR-MATION DES MOINES, IOWA. Corps of Engineers, Rock Island, III.

Army Corps of Engineers Flood Plain Report, April 1970. 65 p, 36 fig, 23 plate, 9 tab.

Descriptors: \*Floods, \*Flood damage, \*Iowa, Flood plains, Regional flood, Flood forecasting, Flood control.

Identifiers: \*Des Moines (lowa), \*Polk County (lowa), Standard project flood, Intermediate regional flood.

Flooding along the Des Moines River Flood Plain starting from Center Street dam in the city of Des Moines to the downstream side of the Saylorville Dam in Polk County, Iowa is described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections, and text material relating the extent of past flooding to floods which might occur in the future are based on available records of rainfall, runoff, historical flood heights and other technical data. The greatest recorded flood flow on the Des Moines River within the study reach occurred on June 24, 1954. The discharge was 60,200 cubic feet per second with a peak stage of 30.16 feet at the Second Avenue gage. The corresponding discharge and stage at the County Road 'W' bridge gage were 60,000 cubic feet per second and 24.50 feet, respectively. (Woodard-USGS) W71-08939

A SYSTEM FOR DETECTING FLUORESCENT TRACERS IN STREAMFLOW,
Bureau of Reclamation, Denver, Colo. Engineering

and Research Center.
For primary bibliographic entry see Field 07A.
W71-08940

SURFACE WATER SYSTEM - OPERATIONAL HANDBOOK, Wyoming Univ, Laramie.

For primary bibliographic entry see Field 07C. W71-08941

#### 2F. Groundwater

SWASH ZONE PROCESSES: AN EXAMINA-TION OF WATER MOTION AND THE RELA-TIONS BETWEEN WATER MOTION AND FORESHORE RESPONSE ON SOME MIXED SAND AND SHINGLE BEACHES, KAIKOURA, NEW ZEALAND,

For primary bibliographic entry see Field 02J. W71-08325

WATER RESOURCES IN THE UPPER STONES RIVER BASIN, CENTRAL TENNESSEE,

Geological Survey, Nashville, Tenn. Charles R. Burchett, and Gerald K. Moore. Tennessee Division Water Resources, Water Resources Series No 8, 1971. 62 p, 42 fig, 3 tab, 26

Descriptors: \*Tennessee, \*Hydrogeology, \*Water resources development, \*Water supply, \*Water yield, Discharge (Water), Groundwater, Aquifer characteristics, Surface water, Domestic water, Aquifers, Fresh water, Hydrologic cycle, Subsurface waters, Water sources, Water storage, Rock properties, Connate water, Data collections, Hydrologic data, Water quality, Joints (Geology), Municipal water.

Identifiers: \*Murfreesboro (Tenn), \*Rutherford County (Tenn), \*Nashville Basin, \*Upper Stones River Basin (Tenn), Water availability, Solution

The upper Stones River basin, an area of 571 square miles in central Tennessee, is characterized by the soil cover overlying limestone formations. The formations generally are poor of water-storing (yielding) capability, resulting in low to moderate groundwater yield and highly variable streamflow. Groundwater is available in most of the basin, primarily from cracks and solution cavities in the limestone bedrock. Springs occur throughout the basin but are more numerous in the eastern part where they are located near or at the base of the steep ridges that form the Highland Rim. The steep ridges that form the Highland Rim. The minimum yield of springs within the basin ranges from less than I gallon per minute to more than 800. The chemical quality of groundwater varies from place to place in the basin, and 80 percent of the wells yield water that is very hard (more than 180 milligrams per liter). Murfreesboro's water

supply is furnished from a spring and from East Fork Stones River whereas Woodbury's water supply is furnished entirely from a spring. Four rural water utility districts buy water from these municipalities and pipe the water to the rural residents both inside and outside the upper Stones River basin. The potential water supplies of the municipalities of Woodbury, Readyvile, Murfreesboro, Lascassas, Walter Hill, Milton, and Christiana are described as to water availability and yield. (Glasby-USGS)

WATER RESOURCES OF WARD COUNTY.

D. E. White.
Texas Water Development Board Report 125, Feb 1971. 219 p, 31 fig, 9 tab, 48 ref.

Descriptors: \*Hydrogeology, \*Water resources development, \*Aquifers, \*Texas, \*Groundwater, Water quality, Water yield, Recharge, Infiltration, Seepage, Return flow, Brines, Salinity, Evapotranspiration, Data collections, Hydrologic data, Withdrawal, Water wells, Water utilization, Consumptive use, Water balance. Identifiers: \*Ward County (Tex).

Ward County is an area of 827 square miles in the Pecos River Valley of West Texas. The county consists primarily of rolling uplands used largely for ranching. The Pecos River borders the county on the south and west. The flood plain and terraces along the river are extensively cultivated and irrigated. During 1967, total pumpage of groundwater from three aquifers totaled 34,400 acre-feet. Water for irrigation is supplied both by wells and from the Pecos River. In 1967, pumpage for irrigation was 9,200 acre-feet, and diversion of river water was 75,510 acre-feet. More than one-half of the water diverted was lost to seepage from canals. water was 75,510 acre-feet. More than one-half of the water diverted was lost to seepage from canals. Natural recharge is estimated to be about 12,000 acre-feet per year, and about 45,000 acre-feet was added to this in 1967 by seepage and deep percola-tion losses. Natural discharge is estimated at 40,000 acre-feet, or about three times the amount of natural recharge. The quality of the groundwater ranges from fresh to brine. Additional development of the Allurosa aquifer is anticipated, with most of the water being obtained from the 10 million acrethe water being obtained from the 10 million acrefect that is estimated to be in storage. However, a large part of the water in storage is too highly mineralized for drinking purposes and can be used only to irrigate the more salt-tolerant crops. (K-napp-USGS)
W71-08331

HYDROGEOLOGIC CHARACTERISTICS OF THE VALLEY-FILL AQUIFER IN THE ARKANSAS RIVER VALLEY, BENT COUNTY, COLORADO,

Geological Survey, Denver, Colo. For primary bibliographic entry see Field 07C. W71-08333

CAPILLARY TUBE THEORY AND THE EFFECT OF THE PORE-SIZE DISTRIBUTION INDEX FOR DRAINAGE IN POROUS MEDIA, Asian Inst. of Tech., Bangkok (Thailand). Dept. of

Asian Institute of Technology, 1969. 67 p, 9 fig, 9 ref, 2 append.

Descriptors: \*Groundwater movement, \*Saturated flow, \*Porous media, \*Pore pressure, Drainage, Porosity, Flow rates, Theoretical analysis, Model studies, Numerical analysis, Equations, Hydraulic conductivity, Capillary conductivity, Permeability, Water table, Analytical techniques. Identifiers: \*Pore-size distribution.

A theoretical investigation of the one-dimensional drainage of an initially saturated medium by the effect of gravity to a water table was studied. Approx-

# Field 02—WATER CYCLE

## Group 2F—Groundwater

imate solutions were developed describing the accumulated volume of flow per unit cross-sectional area to the water table as a function of time and measurable soil properties. The approximate solutions were obtained using an analogy of a capillary tube and the effect of the pore-size distribution index of porous media. The final solutions were given in an integral form which were numerically integrated. The validity of the theoretical equations were verified by comparison with experimental data obtained by previous investigators. (Woodard-USGS) imate solutions were developed describing the ac-USGS) W71-08340

PORE-SIZE DISTRIBUTION OF A POROUS MEDIUM AND ITS APPLICATION,

Asian Inst. of Tech., Bangkok (Thailand). Dept. of

Ying-Yeung Ho.
M Sc Thesis No 306, Asian Institute of Technology,
1970. 114 p, 30 fig, 8 tab, 22 ref, 3 append.

Descriptors: \*Groundwater movement, \*Porous Descriptors: "Groundwater movement, "Footus media, \*Porosity, \*Pore pressure, Saturated flow, Drainage, Flow rates, Theoretical analysis, Model studies, Numerical analysis, Equations, Hydraulic conductivity, Capillary conductivity, Analytical techniques, Permeability. Identifiers: \*Pore-size distribution.

This theoretical investigation considered the characteristics of pore-size distribution of a medium and its applications. An equation relating the effective saturation with capillary pressure was proposed as the pore-size distribution function of the medium. Theoretical equations of hydraulic conductivity for wetting and nonwetting fluids were developed as functions of capillary pressure and saturation using the pore-size distribution proposed in this study. The theoretical equations were then verified by experimental data obtained by previous investigators. The pore-size distribution function was also applied to solve two case studies of drainage problems; one-dimensional vertical drainage of initial saturated media and two-dimensional drainage into open ditches or tile drains. The theoretical solution of the one-dimensional drainage was verified using numerical and experimental results from previous investigators. (Woodard-USGS)

THE SIGNIFICANCE OF THE OGALLALA FORMATION IN TEXAS, International Center for Arid and Semi-arid Land

Studies, Lubbock, Texas.

Frank B. Conselman.

In: The Ogallala Aquifer.-a Symposium, Texas Tech University, Lubbock, International Center for Arid and Semi-Arid Land Studies Special Report No 39, p 2-4, 1970. 3 p.

Descriptors: \*Aquifers, \*Hydrogeology, \*Texas, Reviews, Water yield, Water storage, Water utilization, Transmissivity, Permeability, Porosity, Withdrawal, Water quality, Groundwater move-ment, Recharge, Irrigation water, Water resources development. Identifiers: \*Ogallala aquifer (Texas).

The Ogallala aquifer of Texas underlies 35,000 square miles, and has an average saturated reservoir thickness of 140 feet. Porosity averages 30%, and specific yield is 15%. Transmissibility is about 30,000 gallons per day per foot. In 1968 the Texas Ogallala provided 9.8 million acre-feet of water, equal to 73% of all the groundwater withdrawals in Texas. Moreover, water withdrawn as groundwater from the Ogallala was almost twice as much as the total water usage from all surface storage in the total water usage from all surface storage in the state. Irrigation gets most of the present withdrawals; municipal and industrial use gets about 22%, AND A SMALL PERCENTAGE IS USED IN WATER—FLOODING OF OIL FIELDS FOR SECONDARY RECOVERY. These withdrawals far exceed recharge rates. (See also W71-08350 thru W71-08357) (Knapp-USGS) W71-08340 W71-08349

THE OGALLALA FORMATION--A REVIEW,

Illinois State Geological Survey, Urbana.

Ininois State Geological Survey, Orbana.

John C. Frye.
In: The Ogallala Aquifer—A Symposium, Texas
Tech University, Lubbock, International Center for
Arid and Semi-Arid Land Studies Special Report
No 39, p 5-14, 1970. 10 p, 3 fig, 13 ref.

Descriptors: \*Aquifers, \*Hydrogeology, \*Texas, Stratigraphy, Transmissivity, Permeability, Porosity, Water quality, Structural geology, Groundwater, Water resources development, Topography,

Geomorphology.
Identifiers: \*Ogallala aquifer (Texas).

The Ogallala formation was deposited during late Miocene and Pliocene time in pre-existing valley systems across the Great Plains by streams flowing eastward to southeastward from sources in the mountains. Late Tertiary or earliest Quatennary warping placed the coalescent alluvial deposits in a position vulnerable to Pleistocene erosion, and as a result they now stand as a plateau between the eroded mountain foreland and the central interior eroded mountain foreland and the central interior plains. Hydrologic properties of the Ogallala are strongly influenced by the predepositional topography, the aligment of the filled valleys and of the major channel gravels, and by the hydrologic barriers, particularly buried soils in the upper half of the formation. (See also W71-08349) (Knapp-W71-08350

GEOLOGY AND GROUNDWATER IN THE OGALLALA FORMATION AND UNDIFFERENTIATED PLEISTOCENE DEPOSITS, SOUTHWESTERN KANSAS,

Geological Survey, Garden City, Kans.
Harold E. McGovern.
In: The Ogallala Aquifer--A Snymposium, Texas
Tech University, Lubbock, International Center for
Arid and Semi-Arid Land Studies Special Report
No 39, p 15-29, 1970. 15 p, 9 fig, 10 ref.

Descriptors: \*Aquifers, \*Hydrogeology, \*Paleohydrology, \*Sedimentation, \*Kansas, Strategraphy, Artesian wells, Water yield, Water levels, Water resources development, Withdrawal, Irrigation water, Permeability, Porosity, Transmissivity, Recharge, Groundwater movement. Identifiers: \*Ogallala Aquifer (Kansas).

As a result of subsidence in the underlying Permian red beds, Ogallala deposits in much of southwestern Kansas were buried beneath younger sediments. Early Pleistocene streams carved into the Ogallala, forming a deep southeast-trending valley system. Initial refilling of the basin was by alternating fine- to course-grained stream deposits followed by deposition of thick beds of fine-grained lacustrine sediments. During the late Pleistocene time, rejuvenated streams cut channels into older deposits and refilled the remainder of the basin with alternating fine- to course-grained sediments. The sequence of geomorphic events is reflected in the variety of unconfined and semiconfined conditions that exist within the groundwater reservoir. tions that exist within the groundwater reservoir. Wells in the upper materials generally show characteristics of an unconfined aquifer. Wells screened in the lower materials show characteristics of a semiconfined aquifer. Water levels are declining as a result of pumpage from more than 5,000 wells. The annual rate of decline depends upon the density of irrigation development, the intensity of pumpages and the degree of aquifer configuration. age, and the degree of aquifer confinement. Areas of great saturated thickness and intensive development have shown significant declines in artesian pressure, but well yields remain undiminished. (See also W71-08349) (Knapp-USGS) W71-08351

THE USE OF WELL LOGGING IN RECHARGE STUDIES OF THE OGALLALA FORMATION,

Geological Survey, Lubbock, Tex.

W. S. Keys, and R. F. Brown.
In: The Ogallala Aquifer--A Symposium, Texas
Tech University, Lubbock, International Center for
Arid and Semi-Arid Land Studies Special Report No 39, p 31-48, 1970. 18 p, 9 fig, 5 ref.

Descriptors: \*Borehole geophysics, \*Logging (Recording), \*Texas, \*Permeability, \*Hydrogeolo-\*Logging gy, Subsurface investigations, Aquifers, Artificial recharge, Water spreading, Infiltration, Porosity, Soil moisture, Nuclear moisture meters, Radioactive well logging.
Identifiers: \*Well logging, \*Ogallala aquifer (Tex-

The Geological Survey initiated a major study of artificial recharge at Lubbock, Texas, in fiscal year 1969. This paper deals with the use of geophysical well-logging in investigations of artificial recharge through water-spreading on the land surface. One of the major research efforts is to develop methods for measuring or estimating the vertical permeabili-ty of the unsaturated zone so that favorable sites for surface spreading can be selected on the basis of drilling, logging, and testing. Logging is used to guide construction of air-permeability holes and may be used to provide porosity and moisture data for the calculations. One of the purposes of well logging and sampling is to describe the unsaturated part of the Ogallala Formation with sufficient accuracy to permit development of a correlation between air and water permeabilities and other lithologic parameters. (See also W71-08349) (K-napp-USGS)
W71-08352

LINEAR FEATURES AND GROUNDWATER DISTRIBUTION IN THE QUALLALA FORMATION OF THE SOUTHERN HIGH PLAINS,

Geological Survey, Denver, Colo.
Warren I. Finch, and James C. Wright.
In: The Ogallala Aquifer-A Symposium, Texas
Tech University, Lubbock, International Center for
Arid and Semi-Arid Land Studies Special Report
No 39, p 49-57, 1970. 9 p, 4 fig, 8 ref.

Descriptors: \*Hydrogeology, \*Structural geology, \*Aquifers, \*Texas, Fractures (Geology), Faults (Geology), Water resources development, Artificial recharge, Permeability, Infiltration, Recharge, Grandwater reconstruction Groundwater movement.
Identifiers: \*Ogallala aquifer (Tex).

The southeast-trending Running Water Draw-White River lineament and the nearly parallel Double Mountain Fork line are based on linear topography and associated drainages and on alinements raphy and associated oraniages and on ainements of closely spaced depressions developed on the upper flat caliche caprock surface of the Ogallala Formation in eastern New Mexico and West Texas. The approximate restored post-Ogallala surface of the High Plains appears to be faulted along the Running Water Draw-White River lineament. The thick zone of the water-saturated Ogallala lies north of the Double Mountain Fork line and extends along the Running Water Draw-White River lineament. It is suggested that artificial recharge of the Ogallala aquifer may be best done along linear depictions and oliments for the control of th drainages and alinements of depressions. (See also W71-08349) (Knapp-USGS) W71-08353

DRAINAGE PATTERN ANALYSIS, SOUTHERN HIGH PLAINS, WEST TEXAS AND EASTERN NEW MEXICO,

Texas Technological Coll. Lubbock. Dept. of Geosciences.

C. C. Reeves Jr.

In: The Ogallala Aquifer--A Symposium, Texas Tech University, Lubbock, International Center for Arid and Semi-Arid Land Studies Special Report No 39, p 58-71, 1970. 14 p, 4 fig, 2 tab, 40 ref.

Descriptors: \*Structural geology, \*Hydrogeology, \*Aquifers, \*Texas, Fractures (Geology), Faults (Geology), Water resources development, Artificial recharge, Permeability, Groundwater movement, Infiltration. Identifiers: \*Ogallala aquifers (Texas).

The regional drainage pattern and the locations of large pluvial lake basins on the southern High Plains, West Texas and eastern New Mexico, are controlled by three lineament directions which cor-

## Groundwater—Group 2F

respond to the world's deep-seated regmatic fracrespond to the world's deep-seated regmante frac-ture pattern. The strict control of Pleistocene drainage and of the pluvial lake basins, yet the divergance of the drainage established by the etched dune pattern northeast of Lovington, New Mexico, indicates the most recent movement along the regmatic shears was in post-Pliocene but pre-Late Pleistocene time. Examination of the Ogallala outcrops along the 'caprock' caliche escarpments of eastern New Mexico and West Texas fails to reveal any fracture systems, although polygonal jointing locally occurs on outcrops of the lower part of the Ogallala. The Ogallala section consists mainly of incompetent sands, sits, clays and gravels which would not be expected to maintain open fractures long after formation. (See also W71-08354) (Knapp-USGS)

DIGITAL SIMULATION OF THE OGALLALA AQUIFER IN SHERMAN NORTHWESTERN KANSAS, COUNTY.

Kansas State Geological Survey, Lawrence; and

Geological Survey, Lawrence, Kans.
Thomas J. McClain, and Edward D. Jenkins.

In: The Ogallala Aquifer--A Symposium, Texas Tech University, Lubbock, International Center for Arid and Semi-Arid Land Studies Special Report No 39, p 72-88, 1970. 17 p, 10 fig, 2 tab, 5 ref.

Descriptors: \*Simulation analysis, \*Computer programs, \*Water balance, \*Aquifers, \*Water resources development, Kansas, Recharge, Withdrawal, Discharge (Water), Groundwater movement, Transmissivity, Irrigation water, Municipal water, Water sources, Groundwater, Water levels, Water utilization, Hydrologic budget, Watersoney Hydrogeology.
Identifiers: \*Ogallala aquifer (Kansas).

An area of 340 square miles in Kansas was selected for the purpose of developing a digital model of the Ogallala aquifer. The selected area has 253 irrigation, four industrial, and seven municipal wells. Withdrawal from 1966 through 1969 was computed for each well from municipal, industrial, and power-company records. Aquifer tests and waterlevel measurements were made at selected wells to determine average aquifer coefficients. A digital computer model was used to simulate inflow, outflow, water levels, recharge, transmissivity, storage coefficient, saturated thickness, and yield. After the model was tested and found to be generally compatible with actual field conditions during 1966 through 1969, it was programmed to define the effects of future development (1970 through 1989). Water-level declines related to time and rate of pumpage illustrate the results of the simula-tion. (See also W71-08349) (Knapp-USGS) W71-08355

# NUMERICAL MODEL OF THE OGALLALA AS

A MANAGEMENT TOOL, Texas Technological Coll. Lubbock. Dept. of Civil

Engineering. For primary bibliographic entry see Field 06A. W71-08356

ISOTOPE COMPOSITION OF UNDERGROUND BRINES AS AN INDICATOR OF THEIR ORIGIN (RUSSIAN: OB IZOTOPNOM SOSTAV PODZEMNYKH RASSOLOV KAPOKAZATELE IKH PROISKHOZHDENIYA), KAK

Institut Prirodnogo Gana. Moscow (USSR).

A. I. Polivanova. Geokhimiya No 7, p 829-837, July 1970. 5 fig, 1 tab, 20 ref.

Descriptors: \*Brines, \*Deuterium, \*Groundwater, \*Saits, Evaporation, Infiltration, Sea water, Foreign research.
Identifiers: \*USSR, Isotope compositon, Isotope exchange, Mineralization.

Data on recent attempts to use deuterium as an indicator of the origin of underground brines are reviewed. A low content of deuterium usually is considered a direct indicator of the infiltration origin of groundwaters. Facts indicate, however, that brines formed from prolonged evaporation also have a low deuterium content. A low deuterium content can be shown to be associated with a change in the brine composition during evapora-tion from a sodium brine to a magnesium brine, which results in a sharp change in the structure of the solution. The content of heavy isotopes in evaporation brines is influenced not only by isotope exchange between liquid and atmospheric vapor but also by the concentration of dissolved salts and their composition. It is assumed that the isotope composition of the waters of evaporite basins of various geological epochs differs from that of the waters of the world's oceans and that the waters of the basins may be either deficient or rich in heavy isotopes, depending upon the degree of brine con-centration. The deuterium content cannot be concentration. The deuterium content cannot be considered as an indicator of the origin of underground brines; therefore, there is no justification for assuming an infiltration origin for a brine on the sole basis of a low deuterium content. (Josefson-USGS)

# STEADY DRAINAGE OF LAYERED SOILS: I,

THEORY,
Iowa State Univ. of Science and Technology,
Ames. Water Resources Research Inst.

Likeling raphic entry see Field 02G. For primary bibliographic entry see Field 02G. W71-08520

# STEADY DRAINAGE OF LAYERED SOILS: II,

NOMOGRAPHS, lowa State Univ. of Science and Technology, Ames. Water Resources Research Inst. For primary bibliographic entry see Field 02G. W71-08521

SEA-WATER INTRUSION: BOLSA-SUNSET AREA, ORANGE COUNTY, California Dept. State of Water Resources, Sacra-

mento.

For primary hibliographic entry see Field 05B. W71-08527

#### GEOLOGICAL SURVEY RESEARCH 1970. CHAPTER A.

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 02E. W71-08532

THE PROTECTION OF GROUNDWATER RESOURCES.

For primary bibliographic entry see Field 04B.

WATER FLOWS IN FISSURED ROCK AND THEIR EFFECTS ON THE STABILITY OF ROCK MASSIFS, Karlsruhe Univ. (West Germany).

For primary bibliographic entry see Field 08E. W71-08544

THE HYDROGEOLOGICAL INVESTIGATION OF FISSURE-FLOW BY BOREHOLE LOGGING TECHNIQUES,

Institute of Geological Sciences, London (England), Dept. of Hydrogeology.
Tom Keith Tate, Anne Shirley Robertson, and

David Alfred Gray.

Quarterly Journal of Engineering Geology, Vol 2, No 3, p 195-215, Feb 16, 1970. 21 p, 4 fig, 5 plate, 5 tab, 13 ret append.

Descriptors: \*Groundwater movement, \*Borehole geophysics, \*Logging (Recording), \*Electrical well logging, \*Borehole cameras, Artesian wells, Fissures (Geology), Limestones, Aquifers, Aquifer characteristics, Karst. Identifiers: \*Borchole television.

The instrumentation and techniques developed for the investigation of fissure-flow in consolidated aquifers are described and illustrated by three case histories. The use of closed-circuit underwater television inspection of boreholes is outlined and consideration is given to the implications of flow rates by analysis of the tritium contents of some rates by analysis of the tritium contents of some water samples. Borehole-logging methods were used to identify the strata forming the walls of the well, to locate fissures, and to measure the physical properties of the column of the water in the well. The identification and the location were undertaken with conventional logging equipment as well as with a closed-circuit underwater television camera. (Knapp-USGS) W71-08547

SOME ASPECTS OF THE TRIASSIC AQUIFER IN EAST DEVON AND WEST SOMERSET,
Sherrell (Frederick) Engineering Geologists,
Tavistock (England).
Frederick William Sherrell.
Quarterly Journal of Engineering Geology, Vol 2,
No 4, p 255-286, May 27, 1970. 32 p, 15 fig, 9 tab,
14 ref.

Descriptors: \*Water resources development, \*Hydrogeology, \*Aquifer characteristics, \*Sand-stones, \*Limestones, Water wells, Water levels, Safe yield, Conjunctive use, Induced infiltration, Transmissivity.
Identifiers: \*England, Devon (England), Somerset

(England).

The geology of the Triassic in east Devon and west Somerset, England, is reviewed, and new informa-tion relating to aquifer thickness and the changes in particle size is presented. These factors, together with the degree of cementation of the strata, have a great influence on infiltration, storage and yield. Changes in lithology take place in the aquifers with latitude. These changes play a dominant role in groundwater yield. In the uncemented aquifer in east Devon, the yield from a borehole is closely associated with the saturated thickness, but local variations may occur, due to induced recharge from streams or rivers. The risk of saline contamination will prevent development of the aquifer in the coastal area of south-east Devon. In west Somerset, a yield of the order of 5000 gal/hr or less is to be expected. Although adequate infiltration may occur and a high theoretical yield may be in-dicated, the geological conditions are such that a dense distribution of small diameter boreholes, approximately 8 inches (0.203 m), would be required to bring about the maximum practicable abstraction. (Knapp-USGS)
W71-08548

A CONTRIBUTION TO THE ANALYSIS OF RECOVERY DATA FOR THE DETERMINATION OF THE HYDRAULIC PROPERTIES OF AN AQUIFER,

Geological Survey of Denmark, Copenhagen. For primary bibliographic entry see Field 04B. W71-08549

BASIN RECHARGING THE OGALLALA AQUIFER THROUGH PLEISTOCENE SEDI-

Agricultural Research Service, Bushland, Tex. Soil and Water Conservation Research Div. For primary bibliographic entry see Field 04B. W71-08570

COMPARISION OF METHODS FOR DETER-MINING THE SPECIFIC YIELD OF THE OGALLALA,

Southwestern Great Plains Research Center, Bushland, Tex.

Ordie R. Jones, and Arland D. Schneider.

In: The Ogallala Aquifer--A Symposium, Texas Tech University, Lubbock, International Center for Arid and Semi-Arid Land Studies Special Report No 39, p 118-130, 1970. 13 p, 6 fig, 2 tab, 9 ref.

# Field 02—WATER CYCLE

# Group 2F—Groundwater

Descriptors: \*Specific yield, \*Aquifers, \*Texas, Pumping, Nuclear moisture meters, Cores, Tracers, Groundwater movement, Withdrawl, Storage coefficient, On-site tests, Laboratory tests, Water levels, Recharge, Hydrogeology. Identifiers: \*Ogallala aquifer (Texas).

In order to evaluate and compare the results of dif-ferent methods of determining specific yield, the specific yield of the Ogallala aquifer at the USDA Southwestern Great Plains Research Center, Bushland, Texas, was determined by (1) pump and recharge tests (2) the neutron method (3) tracer techniques and (4) laboratory analyses of cores. The method selected to analyze nums and recharge recharge tests (2) the neutron method (3) traces techniques and (4) laboratory analyses of cores. The method selected to analyze pump and recharge test data is important. Generally, Jacob's straightline method gave smaller values of (8) than did the curve matching methods, although both are solutions of the nonequilibrium formula. The specific yield of the aquifer was also determined with a neutron moisture meter. Nitrate can be used as a tracer for water recharged to the Ogallala. The difference between the specific yield setermined by tritium and nitrate was due mainly to difficulty in accounting for the nitrate present in the native groundwater. Specific yield values were determined for over 100 1-foot long 3-inch diameter undisturbed cores from the Ogallala at Bushland. The specific yield of the aquifer at Bushland is greater than 0.20 and is probably 0.22. The average specific yield determined by pump test was 0.15. (See also W71-08349 thru W71-08357) (Knapp-USGS) USGS) W71-08571

WATER TRANSFER AT BEDROCK-ALLUVI-UM CONTACTS,

Colorado State Univ., Fort Collins. Dept. of Geolo-

James F. Waltz.
In: The Ogallala Aquifer--A Symposium, Texas
Tech University, Lubbock, International Center for
Arid and Semi-Arid Land Studies Special Report
No 39, p 145-153, 1970. 9 p, 5 fig, 6 ref.

criptors: \*Groundwater movement, \*Aquifers, \*Colorado, \*Groundwater basins, Discharge (Water), Recharge, Water management (Applied), Withdrawl, Simulation analysis, Water levels, Hydrogeology. Identifiers: \*Ogallala aquifer (Colo).

Preliminary investigations indicate that appreciable Preliminary investigations indicate that appreciaoue volumes of water may be passing through the contact between the alluvial aquifers and the supposedly impermeable bedrock in the High Plains, Kiowa-Bijou, and Black Squirrel Designated Basins of Colorado. The principal aquifer in the High Plains of Colorado is the Ogaliala Formation of Plaicage, age. The underlying hedrock consists. Plains of Colorado is the Oganala Formation of Pliocene age. The underlying bedrock consists mainly of the Cretaceous Pierre Shale Formation. In the northern portion of the area, however, the Ogallala Formation is underlain by the Oligeocene White River Group. Groundwater is transferred from the Ogallala aquifer through the nearly horizontal channel deposits of the White River Group northwestward into the alluvium of the South Platte River. Quaternary and recent stream deposits are the principal aquifer in the Kiowa-Bijou basin. Beneath the alluvial aquifers lie the Cretaceous sediments of the Pierre Formation, Fox Hills Formation, and the Larmie Formation. Piezometric levels exceeded water table levels in several areas; hydraulic conditions cause groundwater to move from the Fox Hills aquifer into the alluvium in these localities. Preliminary results from a computer simulation of groundwater flow within a portion of the Black Squirrel Creek Basin show that approximately 4,000 acre feet of ground-water passes from the alluvial aquifer into the Fox Hills Sandstone each year. (See also W71-08349 thru W71-08357) (Knapp-USGS) W71-08572

METHOD FOR ESTIMATING AVERAGE COEFFICIENT OF PERMEABILITY USING HYDROGEOLOGIC FIELD DATA, Geological Survey, Cheyenne, Wyo.

Richard Howard Pearl.

In: The Ogallala Aquifer—A Symposium, Texas Tech University, Lubbock, International Center for Arid and Semi-Arid Land Studies Special Report No 39, p 131-144, 1970. 14 p, 2 fig, 5 tab, 6 ref.

Descriptors: \*Permeability, \*Aquifers, \*Kansas, Alluvium, Particle size, Groundwater movement, Laboratory tests, Anistropy, Stratigraphy, Regression analysis, Statistical methods, Correlation analysis, Hydrogeology. Identifiers: \*Ogallala aquifer (Kansas).

The relations between average permeability and particle-size distribution in the Ogallala aquifer of Kansas were derived by multiple regression. The only size fractions significantly correlated with permeability were found to be fine and very fine gravel. This result is in conflict with most laboratory studies wherein the permeability was found to be highly correlated with the smaller-size fractions. Most laboratory measurements are made on sam-Most laboratory measurements are made on samples taken perpendicular to the bedding planes, but average permabilities of interest in the field relate to flow parallel to the bedding planes. Therefore, correlations between permeability to horizontal flow and the larger size fractions may be of greatest significance for field use. (See also W71-08349 thru W71-083573 (Knapp-USGS)

PROBLEMS OF ARTIFICALLY RECHARGING THE OGALLALA FORMATION IN COLORADO,

Geological Survey, Denver, Colo. For primary bibliographic entry see Field 04B. W71-08574

A MATHEMATICAL MODEL FOR DETERMIN-ING AREAL DISTRIBUTION OF NATURAL RECHARGE IN THE NORTHERN HIGH PLAINS OF COLORADO, Texas A and M Univ., College Station. Dept. of Agricultural Engineering.

Donald L. Reddell.

In: The Ogallala Aquifer-A Symposium, Texas Tech University, Lubbock, International Center for Arid and Semi-Arid Land Studies Special Report No 39, p 165-181, 1970. 17 p, 8 fig, 3 tab, 4 ref.

Descriptors: \*Groundwater recharge, \*Aquifers, \*Colorado, \*Mathematical models, Simulation analysis, Numerical analysis, Groundwater movement, Infiltration, Permeability, Water yield, Discharge (Water), Hydrogeology. Identifiers: \*Ogallala aquifer (Colo).

The average annual rate and areal variation of natural recharge to the Ogallala Formation in the Northern High Plains of Colorado were studied using a mathematical model checked by review data collections. The distribution of recharge apdata concertons. The distribution of technice ap-pears to be largely a function of the surface condi-tions as reflected by the geology, soils and topog-raphy of the area. For instance, net recharge rates in excess of two inches per year are primarily confined to the sandhill portion of the study area. These sandhills lie mostly above the water table. have a permeability, and a poor surface drainage system. The total volume of net recharge to the Ogallala Formation in Northern Colorado was computed to be 405,000 acre-feet per year or an average of about about 0.82 inch per year over the entire study area. This compared favorably with a previous estimate of 0.85 inch per year. The finite difference method of calculating net recharge is limited in its quantitative results by the quality of the input data. The best check available of the applicability of the method to field conditions is shown by the close correlation between the net discharge calculation from the finite difference method and the amount of discharge as estimated from stream flow measurements on the north and south forks of the Republican River and the Arikaree River. (See also W71-08349 thru W71-08357) (Knapp-USGS)
W71-08575

GROUNDWATERS OF MAGNESITE KARST IN CZECHOSLOVAKIA (GERMAN: UNTERIR-DISCHE WASSER DES MAGNESITKARSTES IN DER CSSR),

Stanislav Klir.
English abstract. Steirische Beitrage zur Hydrogeologie, No 20, Graz, p 5-22, 1968. 18 p, 5 fig, 5 ref.

Descriptors: \*Karst, \*Mine water, \*Hydrogeology, Erosion caves, Clays, Mine drainage, Iron, Leaching, Solubility, Groundwater movement. Identifiers: \*Czechoslovakia, \*Magnesite.

The karstification of the magnesite deposits in the carboniferous strata of the Slovacian Gemerides is directly related to the direction of large faults. The intensity of the karstification is proportional to the intensity of the faults. The fissures and caves of the magnesite karst are usually filled with ochres developed through precipitation of iron from underground water as well as through the leaching of the carbonear rocks. Liberal flow of underground water course the discharge of ochre from the karst the carbonate rocks. Liberal flow of underground water causes the discharge of ochre from the karst caves into nearby mine shafts. Reduction of the waterflow causes consolidation of the ochre. This consolidation is accompanied by swelling of the ochre, which endangers mining work in parts of the deposit in which the swelling causes accumulation of water in the karst caves. (Knapp-USGS) W71-08576

WATER MANAGEMENT OF THE VOGEL-SBERG BASALT PALEOZOIC VOLCANO IN HESSEN (GERMAN: UBER DEN WASSER-HAUSHALT DES BASALTISCHEN PALAOVUL-KANS VOGELSBERG IN HESSEN),

Oberhessische Versorgungsbetriebe, Hung (West Germany). Geologische Forschungsstelle. E. Schenk.

English abstract. Steirische Beitrage zur Hydrogeologie, No 20, Graz, p 23-50, 1968. 28 p, 11 fig, 20 ref.

Descriptors: \*Hydrogeology, \*Basalts, \*Base flow, Water balance, Water levels, Water table, Surface-groundwater relationships, Surveys, Groundwater movement, Infiltration. Identifiers: Hessen (GRF).

In the basalt area of the Vogelsberg, Hessen, GFR, groundwater runoff into the river Nidda was determined. It is relatively high for the total precipitation area (9 liters per sec per sq km). The infiltration is 15 to nearly 60% of precipitation and depends on the groundwater level. (Knapp-USGS). W71-08577

WASTE OF ARTESIAN WATERS IN EAST STYRIA (GERMAN: RAUBBAU AN ARTE-SISCHEM WASSER IN DER OSTSTEIER-

MARK),
Technische Hochschule, Graz (Austria). Institut fuer Mineralogie und Technische Geologie.
For primary bibliographic entry see Field 04B.
W71-08579

OBSERVATIONS OF THE EFFECT OF EXTREME HIGH WATER IN 1965 AND 1966 ON THE GROUNDWATER BODY OF THE LIENZ BASIN-EAST TIROL (GERMAN: BEOBACHTUNGEN UBER DIE AUSWIRKUNG DER EXTREMEN HOCHWASSER 1965 UND 1966 AUF DEN GRUNDWASSERKORPER IMBECKEN VON LIENZ (OSTTIROL), For primary bibliographic entry see Field 02A. W71-08580

GROUNDWATER IN THE LEIBNITZER FELD, STYRIA (GERMAN: DAS GRUNDWASSER IM

LEIBNITZER FELD, STEIERMARK), Technische Hochschule, Graz (Austria). Institut fuer Mineralogie und Technische Geologie. J. Zotl.

engish abstract. Steirische Beitrage zur Hydrogeologie, no 20, Graz, p 99-151, 1969. 53 p, 25 fig, 1 tab, 18 ref.

Descriptors: \*Hydrogeology, \*Surface-ground-water relationships, Groundwater recharge, Water levels, Reservoir leakage, Alluvium, Alluvial chan-nels, Terraces (Geological), Water level fluctua-tions, Water balance, Hydrologic budget. Identifiers: \*Leibnitzer Feld (Austria), \*Austria.

The groundwater balance in the quaternary gravel body of the Leibnitz Feld, Austria, was studied by investigations conducted over a number of years. East of the Mur River most of the Leibnitz Field is occupied by the holocene river-meadow landscape; west of the Mur, Pleistocene glacial terraces are preserved. Seasonal water level fluctuations result from differences of the geological conditions, the recharge area and the influence of the river. The thickness of the groundwater body decreases from over 8 m in the extreme northeast of the Mur to 3-4 m in the south of the Leibnitz Field. Damming of 4 m in the south of the Leibnitz Field. Damming of the Mur in the course of construction of the power station near Gralla had effects on the groundwater body chiefly in the area on the right bank. There was an immediate and marked but ephemeral rise of the groundwater level; from mid-1965 onward, the natural tightness of the river-bed of the Mur soon stabilized conditions again. Water-table isohypses and serial tests of groundwater hardness justify the assumption that the water of the Mur has penetrated into the groundwater body no farther than 500 m westward. (Knapp-USGS)

# GROUNDWATER IRRIGATION IN THE TIRASPOL' DISTRICT OF MOLDAVIA (RUSSIAN: OROSHENIYE PODZEMNYMI VODAMI V TIRASPOL' SKOM RAYONE MOLDAVII), Yu. I. Voronov.

Gidrotekhnika i Melioratsiya, No 1, p 53-58, Jan 1971. 6 p, 3 fig, 3 tab.

Descriptors: \*Irrigation systems, \*Irrigation wells, \*Artesian wells, \*Reservoir storage, \*Ground-water, Drawdown, Specific capacity, Aquifers, Water storage, Water analysis, Pumping plants, Vegetable crops, Rotations. Identifiers: \*USSR, Moldavia, Irrigation agricul-

Irrigation agriculture in the Tiraspol' Rayon of Moldavia can be developed through the use of groundwater from artesian wells. The static level of groundwater of the region is at a depth of 40-90 m from the soil surface. Depth of water wells is between 90 and 140 m. Specific capacity of wells in the northeastern part of the rayon is 2-5 cu m/hr and in the southeastern part 10 cu m/hr or more. Analysis of water shows that total solids content in most drilled wells does not exceed 1 g/liter and the total hardness of water varies between 4 and 14 meq/liter. To effectively use groundwaters for irrigation it is advisable to store water from artesian wells in reservoirs. Subsurface irrigation systems constructed for the utilization of groundwater are simple in design, easy to operate, and fully pay for themselves in the first few years of operation. (Josefson-USGS)

# SEEPAGE FACE EFFECTS IN UNSTEADY GROUND-WATER FLOW, Wisconsin Univ., Madison. Water Resources

Wisconsin Univ., Madisoli. Water Resources Center.
Willard A. Murray.
Available from the National Technical Information Service as PB-199 831, \$3.00 in paper copy, \$0.95 in microfiche. Technical Report, OWRR B-021-WIS-1, Water Resources Center, The University of Wisconsin-Madison, 1970, 143 p, 21 fig. 10 tab, 56 ref. OWRR Project B-021-WIS (1).

Descriptors: \*Seepage, \*Free surface, \*Dimensional analysis, \*Aquifer, \*Ditches, \*Streams, \*Flow, Water table, Drawdown.

Identifiers: \*Saturated region, \*Fourier analysis,

This study deals with the effect of the seepage face on the location of the free surface in a two-dimensional unconfined aquifer adjacent to a ditch or stream. The analysis is restricted to considering flow only in the saturated region below the water table; unsaturated flow effects are neglected. Theoretical solutions were obtained for steady state conditions and for the transient case of instantaneous drawdown by using potential theory and standard Fourier methods. The steady state solu-tion is a corrected form of that presented by Kirkham (1964), which was found to contain a flaw. The transient solution involves a simple extension of the steady state solution and reduces to the latter for large time. Both solutions are presented in infinite series form. For the steady state, theoretical results indicate that the simple Dupuit parabola will give entirely satisfactory predictions of free surface locations for moderate drawdowns. For the transient case, the derived solutions indicate that the seepage face length decays exponentially. Furthermore, the transient solution including the effect of the seepage face shows a marked difference from the simplified potential solution in which the seepage face effect is neglected, particularly for small times and for locations near the outflow face. Experiments were conducted using a Hele-Shaw viscous flow model to verify the theoretical predictions. W71-08660

# THE TEXAS WATER DEVELOPMENT BOARD COOPERATIVE STUDIES OF THE OGALLALA UNDERGROUND RESERVOIR,

Texas Water Development Board, Austin. Groundwater Div Gunnar Brune

In: The Ogallala Aquifer--A Symposium, Texas Tech University, Lubbock, International Center for Arid and Semi-Arid Land Studies Special Report No 39, p 227-242, 1970. 16 p, 9 fig, 13 ref.

Descriptors: \*Aquifers, \*Texas, \*Groundwater recharge, \*Surveys, Injection wells, Computer programs, Mapping, Subsurface investigations, Water storage, Stratigraphy, Hydrogeology. Identifiers: \*Ogallala Aquifer (Texas).

The Ogallala underground reservoir, underlying the High Plains, furnished 73% of the groundwater and 53% of the total amount of water used in Texas in 1968. The Ogallala reservoir represents approximately 51% of the total underground water storage capacity available in the State, including dewatered, fresh, and slightly saline reservoirs. It has been estimated that 134 million acre-fect of dry or unsaturated underground stroage capacity available in the South High Plains alone. The remaining groundwater in the Ogallala reservoir has declined to very low levels in some areas. The average acreage irrigated per well has declined from 140 acres in 1950 to 84 in 1969. The Texas Water Development Board is concerned about these matters, and has undertaken two cooperative studies involving the Ogallala reservoir. The first study is in cooperation with the High Plains Research Foundation of Halfway, Texas. Using recharge and observation wells, the effects on the aquifer of using runoff water in recharge wells are determined. The second study is in cooperation with the U.S. Geological Survey. This study con-templates the possible use of the Ogallala reservoir for underground storage and transmission of imported or local surface water. (See also W71-08349 thru W71-08357 and W71-08570 thru W71-08575) (Knapp-USGS) W71-08895

# APPLICATION OF SURFACE PRESSURE TO ASSIST WATER RECHARGE INTO THE OGALLALA FORMATION, Texas Tech Univ., Lubbock. Dept. of Petroleum

Engineering. For primary bibliographic entry see Field 04B. MOVEMENT AND RECOVERY OF HERBI-CIDES IN THE OGALLALA AQUIFER.

Agricultural Research Service, Bushland, Tex. Soil and Water Conservation Research Div. For primary bibliographic entry see Field 05B.

# GROUNDWATER CONDITIONS IN THE HARQUAHALA PLAINS, MARICOPA AND YUMA COUNTIES, ARIZONA, Geological Survey, Phoenix, Ariz. For primary bibliographic entry see Field 04B. W71-08900

# SELECTED GROUNDWATER DATA IN THE EUGENE-SPRINGFIELD AREA, SOUTHERN WILLAMETTE VALLEY, OREGON,

Geological Survey, Portland, Oreg. For primary bibliographic entry see Field 07C. W71-08921

#### HYDROLOGIC DATA: 1968, VOLUME 4, SAN JOAQUIN VALLEY.

California State Dept. of Water Resources, Sacramento.

For primary bibliographic entry see Field 07C. W71-08927

# WATER RESOURCES OF THE BIG CREEK DRAINAGE BASIN,

Ontario Water Resources Commission, Torento (Ontario). Div. of Water Resources. For primary bibliographic entry see Field 02E. W71-08935

# GROUND WATER BASIC DATA, HETTINGER AND STARK COUNTIES, NORTH DAKOTA,

Geological Survey, Bismarck, N. Dak

Henry Trapp, Jr.
North Dakota Water Commission County Ground
Water Studies 16, Part 2, 1971. 455 p, 2 fig, 1
plate, 7 tab, 19 ref.

Descriptors: \*Groundwater, \*Water resources development, \*Hydrologic data, \*Aquifer characteristics, \*North Dakota, Water wells, Data collections, Hydrogeology, Aquifers, Water yield, Water levels, Water quality, Chemical analyses, Water utilization, Water temperature, Water sources, Water table, Observation wells, Geology, Springs, Portiole in

Identifiers: \*Groundwater resources, \*Hettinger County (N. D.), Stark County (N. D.).

Hydrologic investigations were made in Hettinger and Stark Counties, N. Dak. to determine the quantity and quality of groundwater available for mu-nicipal, domestic, livestock, industrial, and irrigation uses. The information was collected between 1966 and 1969, and consists of the following: (1) Data on 3,060 wells and test holes; (2) data on 91 pata on 3,000 wells and test noies; (2) data on 91 springs; (3) water-level measurements in 61 observation wells; (4) logs of 544 test holes and wells; (5) chemical analyses of 261 water samples; (6) color values of 331 water samples; and (7) 28 particle-size distribution curves. The data are presented in tables and maps. (Wood-USGS) W71-08938

#### 2G. Water in Soils

WATER REGIME OF MOUNTAIN CHERNOZEMS OF THE KARACHAYEVO-CHER-KESSKAYA AUTONOMOUS REGION (RUS-SIAN: VODNYY REZHIM GORNYKH CHER-NOZEMOV KARACHAYEVO-CHERKESII),

V. A. Baranovskaya. Meteorologiya i Gidrologiya, No 11, p 88-92, Nov 1970. 2 fig, 2 tab, 5 ref.

Descriptors: \*Chernozems, \*Soil moisture, \*Water storage, \*Discharge (Water), Moisture deficit,

W71-08896

# Field 02—WATER CYCLE

# Group 2G-Water in Soils

Precipitation (Atmospheric), Wilting point, Leaching, Agronomic crops, Climatic data, Soils, Seasonal, Transpiration, Evaporation. Identifiers: \*USSR, Mountain Chernozems, Water regime, Moisture capacity, Chronoisopleths.

Mountain Chernozems of the Karachayevo-Cher-kesskaya Autonomous Region are formed at a kesskaya Autonomous Region are formed at a height of 700-1,600 m above sea level under optimal moisture conditions. A station was set up in the region of the Zelenchukskiy Strain-Testing Plot to study the water regime of a typical mountain Chernozem. For two years of observations the moisture deficit averaged about 130 mm in a 0-300 cm soil layer. Fall and winter precipitation averaged 180 mm and was sufficient to wet the entire 3-m layer to minimum moisture capacity. tire 3-m layer to minimum moisture capacity. Discharge of water from spring storage of productive moisture in the 3-m layer of soil during the growing season averaged about 130 mm, with a maximum discharge of 180 mm observed in 1968. Total water discharge during the growing season ranged from 600 to 800 mm. Water discharge from the upper 50-cm layer of soil was 3-4% of the total discharge while that from the 3-m layer was 15-30%. It is concluded from cyclic variations in climate that the water regime of mountain Chernozems is of a periodic leaching type with a predominance of leaching phases. (Josefson-USGS) W71-08369

FIELD STUDIES OF THE INFILTRATION CAPACITY OF SOILS (RUSSIAN: O POLEVYKH ISSLEDOVANIYAKH VPI-TYVAYUSHCHEY SPOSOBNOSTI POCHVO-OF SOILS (RUSSIAN: O ISSLEDOVANIYAKH VPI-

For primary bibliographic entry see Field 04A. W71-08384

#### A THREAT TO OUR IRRIGATION SCHEMES,

Natal Univ., Pietermaritzburg (South Africa). Dept. of Soil Science.

For primary bibliographic entry see Field 03C.

#### PHASE COMPOSITION OF PORE WATER IN COLD ROCKS,

Cold Regions Research and Engineering Lab., Hanover, N.H. Malcolm Mellor.

Available from the National Technical Information Service as AD-719236, \$3.00 in paper copy, \$0.95 in microfiche. CRREL Research Report 292, Dec 1970. 59 p.

Descriptors: \*Rock mechanics, \*Freezing, \*Temperature, \*Thermal properties, Thermal expansion, lce, Soils, Polar regions, Compressability, Cold weather construction, Mechanical properties.

Identifiers: Thermal analysis, Strain mechanics, \*Pore water, \*Interstitial water.

The phase composition of pore water in three types of rock subjected to temperature below 0C was explored by a variety of techniques. Freezing point depression was measured as a function of water content by differential thermal analysis, the results yielding relationships between unfrozen water content and temperature. In an effort to avoid the practical difficulties involved in differential thermal analysis, attempts were made to determine freezing characteristics indirectly by air penetration and mercury penetration techniques applied at ordinary room temperatures. Electrical conductivity measurements were made as a function of temperature down to -195C in an attempt to obtain information on characteristics of interfacial water films at low temperatures. Thermal strain was measured as a function of temperature in order to detect direct mechanical effects associated with phase changes, chiefly strain discontinuities brought about by volume changes in the pore water during rapid freezing and thawing. Finally, isothermal compressibility measurements, with pressures

up to 27 kb, were made at -10C so as to determine whether the rock underwent step changes in volumetric strain at pressures corresponding to those of the phase boundaries for ice polymorphs.

# STEADY DRAINAGE OF LAYERED SOILS: I,

lowa State Univ. of Science and Technology, Ames. Water Resources Research Inst. Sadik Toksoz, and Don Kirkham.

ASCE Proceedings, Journal of the Irrigation and Drainage Division, Vol 97, No IR-1, Paper 7985, p 1-18, Mar 1971. 18 p, 4 fig, 5 ref, append. OWRR Project B-013 - IA (8).

Descriptors: \*Soil water movement, \*Subsurface drainage, \*Groundwater, \*Steady flow, \*Agricultural engineering, Flow nets, Seepage, Soils, Soil water, Theoretical analysis, Mathematical studies, Water table.

Identifiers: \*Underground drains, Layered soils.

The stream and potential functions for the steady The stream and potential functions for the steady drainage of two-layered and three-layered soils were derived. Two sets of flow nets are given for each case. From the derivations for the two-layered and three-layered soils, steady drainage problems for soils with more than three layers may be solved. (See also W71-08521) (Woodard-USGS) W71-08520

# STEADY DRAINAGE OF LAYERED SOILS: II,

NOMOGRAPHS, lowa State Univ. of Science and Technology, Ames. Water Resources Research Inst. Sadik Toksoz, and Don Kirkham.

ASCE Proceedings, Journal of the Irrigation and Drainage Division, Vol 97, No IR-1, Paper 7986, p 19-37, Mar 1971. 19 p, 17 fig, 2 tab, 9 ref, append. OWRR Project B-013-IA (9).

Descriptors: \*Soil water movement, \*Subsurface drainage, \*Groundwater, \*Steady flow, Agricultural engineering, Flow nets, Seepage, Soils, Soil water, Water table, Mathematical studies, Equa-

Identifiers: \*Underground drains, Layered soils, Nomographs.

The drain spacing equations for the two-layered and three-layered soils are given. A set of 16 figures containing 29 nomographs may be used for easy calculation of drain spacings in two-layered soils. Drain spacings calculated by using Dagan's equation for the two-layered soils agree with the spacings calculated from the nomographs. (See also W71-08520) (Woodard-USGS) W71-08521

#### POSSIBLE IMPROVEMENT OF SULPHATE SOILS IN COASTAL AREAS OF ASIA BY MEANS OF SEA WATER LEACHING. Economic Commission for Asia and the Far East, New York.

For primary bibliographic entry see Field 03C. W71-08545

# POROSITY AND PORE-SIZE DISTRIBUTION OF SOIL AGGREGATES, Minnesota Univ., Minneapolis. Dept. of Soil

Available from the National Technical Information Service as PB-199 836, \$3.00 in paper copy, \$0.95 in microfiche. Minnesota Water Resources Research Center, Bulletin 29, 1971. 32 p, 6 fig, 8 tab, 43 ref. OWRR Project A-006-Minn (3).

Descriptors: \*Porosity, \*Soil types, \*Pores, Aggregate, Minnesota, Cultivated lands, Miscroscopic, Bulk density, Voids, Sand, Clay, Silt, Loess, Glacial drift.

Identifiers: \*Pore-size distribution, \*Glassbead displacement, \*Hg-porosimetry, Intraaggregate, Interaggregate, Thin sectioning.

Differences in aggregate porosity due to soil type, aggregate size and cultivation condition were investigated using samples from 6 Minnesota soils.
Porosity characteristics were determined by the glassbead displacement and thin section methods and with Hg-porosimeter measurements. Aggregate porosity was higher in soils developed on gregate porosity was higher in solis developed on loess and lower in those on till. Porosities ranged from 0.253 to 0.497. Aggregate porosity of virgin soil was higher than that of cultivated soil. Specific pore volume of pores of diameters 0.012 to 17 microns ranged from 0.124 to 0.272 cc/g. Over 90% of the specific pore volume was contributed by pores of diameter greater than 0.2 microns. The proportion of intraaggregate porosity to the total porosity was found to be about 0.30 for cultivated soils and 0.30 to 0.40 for virgin soils. (Walton-Minnesota) W71-08663

#### AGING EFFECTS ON SWELL POTENTIAL OF COMPACTED CLAY,

Technion - Israel Inst. of Tech., Haifa (Israel). Dept. of Civil Engineering. Gabriel Kassiff, and Raphael Baker.

ASCE Proceedings, Journal of the Soil Mechanics and Foundations Division, Vol 97, No SM3, Paper 7951, p 529-540, Mar 1971. 12 p, 7 fig, 21 ref, ap-

Descriptors: \*Soil mechanics, \*Clays, \*Compaction, \*Soil water, \*Aging (Physical), Pressure, Soil structure, Soil water movement, Entropy. Identifiers: \*Compacted clay, Inundation, Swelling

The swelling potential of compacted clay, which develops upon inundation, is defined in terms of develops upon infinited and it is a clinical in terms of the parameters affected by aging. These parameters include swell pressure, volume change and suction. Because in nature the clay is exposed to water some time after compaction, the aging effects on the swelling potential are rather important. Compacted clay samples were aged for up to 90 days and then tested for swelling pressure and free swell, using triaxial technique. It was found that the swell pressure, particularly at high initial densities, tends to increase with aging and then gradually to decrease to the initial value of zero aging. The amount of swell (under practically zero load) was not markedly affected by aging. The peak values of the swelling potential amounted to two to three times the initial value, and were found to be dependent on the initial placement conditions of the clay. The results are explained by energy concepts, as well as by concepts mainly used in soil science, such as thixotropy and entropy of clay-water systems. (Woodard-USGS) W71-08904

# THE DEGRADATION OF LIAS CLAY SLOPES IN AN AREA OF THE EAST MIDLANDS, Imperial Coll. of Science and Technology, London

(England). Dept. of Civil Engineering. For primary bibliographic entry see Field 02J. W71-08929

#### 2H. Lakes

INFRARED EXPLORATION FOR SHORELINE SPRINGS AT MONO LAKE, CALIFORNIA, TEST SITE,

Colorado School of Mines, Golden. Dept. of Geology.

For primary bibliographic entry see Field 07B. W71-08359

ISOTOPE COMPOSITION OF URANIUM (U-234, U-238) IN WATERS AND BOTTOM SEDI-MENTS OF LAKE BALKHASH, AND AGE OF THE LAKE (RUSSIAN: IZOTOPNYY SOSTAV URANA (U-234, U-238) V VODAKH I DON-NYKH OSADKAKH OZ. BALKHASH I PRO-

## Water in Plants—Group 21

DOLZHITEL'NOST' SUSHCHESTVOVANIYA

VODOYEMA),
Akademiya Nauk Kirghiz SSR, Frunze. Inst. of
Physics and Mathematics.
P. I. Chalov, N. A. Svetlichnaya, and T. V. Tuzova.
Geokhimiya, No 7, p 848-854, July 1970. 6 tab, 25

Descriptors: \*Uranium radioisotopes, \*Radioactive dating, \*Bottom sediments, \*Lakes, Stable isotooes, Rivers, Surface waters, Deep water,

Identifiers: \*USSR, Lake Balkhash, Isotope com-

The age of Lake Balkhash was determined by nonequilibrium uranium isotope ratios from a study of U-234 and U-238 in bottom sediments and waters of the lake basin. Water samples were taken from the estuaries of all five rivers flowing into the lake and at 30 points along the lake. The results of the study differed significantly from figures obtained by using salt accumulations in calculating the age of water bodies. The isotope composition of uranium in the river waters has remained stable for thousands of years. The non-equilibrium uranium isotope ratio method gives the absolute age of Lake Balkhash as 37 (plus or minus 7) thousand years, which agrees with a number of geological studies. (Josefson-USGS)
W71-08368

#### LAKE VOLTA--A PROGRESS REPORT. Makerere Univ. Coll., Kampala (Uganda).

Tomislav Petr.

New Scientist and Science Journal, Vol 49, No 736, p 178-180, Jan 28, 1971. 2 fig.

Descriptors: \*Lakes, \*Fish harvest, \*Food webs, \*Productivity, Savannas, Trees, Hypolimnion, Tropical regions, Biomass, Vegetation effects. Identifiers: \*Lake Volta, \*Ghana, \*Metalimnion.

Lake Volta in Ghana has extended over former forest and savanna-woodland habitats through 2 climatic zones. The amount of organic matter submerged by the lake is enormous since no prior clearing of vegetation occurred. In the first months of the lake, large fish mortality and low oxygen levels gave rise to many fears which were fortunately unjustified. When the dry harmattan winds reach the area from the Sahara the lake is rigidly stratified but in most areas the metalimnion is fairly deep. Although some species of fish have disappeared from the lake, others have thrived and reached enormous population levels, creating a productive fishery. A simple food web was constructed for the more important species of the lake. Much of the high biomass is attributable to the submerged wood which directly and indirectly provides food for the fish. No one knows what will happen to lake productivity when the wood decays, thereby posing questions on appropriate long term fisheries programs. (Cascy-Arizona) W71-08471

# FORMATION OF SULFUR-BEARING MUDS IN RECENT - CRATER LAKES, (RUSSIAN: USLOVIYA OBRAZOVANIYA SERONOSYNKH ILOV V SOVREMENNYKH KRATERNYKH OZERAKH),

Gosudarstvennyi Nauchno-Issledovatelskii Institut Gornokhimicheskogo Syrya, Lyubertsii (USSR); and Akademiya Nauk SSR, Moscow. Institut Geok-

himii i Analitcheskoi Khimii. A. Yu. Lein, V. A. Grinenko, and M. V. Ivanov. Geokhimiya, No 8 p 988-997, Aug 1970. 10 p, 6 fig, 5 tab, 16 ref.

Descriptors: \*Sedimentation rates, \*Mud-water interfaces, \*Sulfur, \*Mud, \*Geochemistry, Sedi-ment-water interfaces, Sulfates, Sulfur compounds, Sulfides, Craters, Lakes, Acidic water, Water chemistry, Clay minerals, Kaolinite, Hydrogen ion concentration, Diagenesis, Mineralogy.

Identifiers: \*USSR, Kuril Islands, Crater lakes, Fu-

maroles, Chemosedimentation, Halloysite.

The geological and physico-chemical conditions of formation and mineral composition of native sulfur in mud sediments in crater lakes of the Kuril Islands are examined. The character of sediment accumulation in the lakes is determined by interaction of three basic factors: intense uptake of sulfur gases from bottom fumaroles, chemical aggressiveness of ultra-acidic waters, and washing away of clastic and pyroclastic material. The leading process in the formation of sulfur muds in acid crater lakes is chemical precipitation, by which fine-layered sediments of native sulfur (25-55%), opal, alunite and clay minerals are formed. Clay minerals are not formed in the lakes when water pH is less than 1.5; halloysite is formed when pH is 1.5-2.25 and kaolinite is formed when pH is greater than 2.25. Ferric sulfides are formed either at the mud-water boundary when pH is greater than 3 and Eh is less than plus 0.02 volts or in sediment furing diagenesis of muds. The sulfur accumulation rate in crater lakes is hundreds of times greater than ordinary sedimentation. In Lake Goryacheye, for example, average sulfur accumulation is about 48 kg/cu m a year. (Josefson-USGS) W71-08538

NUTRIENT LIMITING FACTORS IN AN OLIGOTROPHIC SOUTH CAROLINA POND, Savannah River Ecology Lab., Aiken, S.C. For primary bibliographic entry see Field 05C. W71-08543

#### 2I. Water in Plants

#### PLANT TEMPERATURES AND HEAT FLUX IN A SONORAN DESERT ECOSYSTEM,

Arizona State Univ., Tempe. Dept. of Botany and

Microbiology.
Joan G. Gibbs, and D. T. Patten.

Oecologia, Vol 5, No 3, p 165-184, 1970. 13 fig, 26

Descriptors: \*Arid lands, \*Xerophytes, \*Energy budget, \*Heat balance, \*Environmental effects, Ecosystems, Physiological ecology, Solar radiation, Temperature, Plant morphology, Arizona, Shrubs, Soil temperature, Conduction, Convection, Boundary layers, Humidity, Transpiration, Evaporation, Cooling, Condensation, Dew, Scasonal, Cacti, Deserts, Leaves.

Identifiers: \*Sonoran Desert, \*Vapor pressure deficit, \*Adaptations, \*Creosotebush, \*Temperature profiles.

Thermocouple temperature measurements were made in spring and summer in 6 Sonoran Desert plant species: Opuntia engelmannii, O. bigelovii, O. acanthocarpa and Echinocereus engelmannii, which are cacti, and Larrea tridentata and Franseria deltoidea, which are shrubs. Daily temperature profiles were constructed and used to compare differing seasonal responses of the various species to desert heat load. Cacti absorbed and stored heat and their internal temperatures often rose well above air temperature. Their various high dissipation mechanisms include critical pad angles with the sun, spine reflectivity, convection, temperature-dependent reradiation and heat dissipation from apical stem to basal stem. The relative importance of each of these mechanisms differ between species. The shrub leaf temperatures were always close to air temperature. Their low surface area/volume ratios ensure the importance of convection as a cooling factor. (Casey-Arizona) W71-08443

# CONTENT OF ADENOSINE PHOSPHATE COMPOUNDS IN PEA ROOTS GROWN IN SALINE MEDIA, Hebrew Univ., Jerusalem, (Israel). Dept. of

Botany For primary bibliographic entry see Field 03C.

W71-08447

# CYTOKININ ACTIVITY IN WATER-STRESSED

Negev Inst. for Arid Zone Research, Beersheba

(Israel). Div. of Life Sciences.
Chanan Itai, and Yoash Vaadia.
Supported by the USDA under contract FG-IS-32.
Plant Physiology, Vol 47, No 1, p 87-90, Jan 1971.
I fig, 4 tab, 20 ref.

Descriptors: \*Moisture stress, \*Leaves, \*Plant growth substances, Laboratory tests, Humidity, Radiochemical analysis, Plant physiology. Identifiers: \*Cytokinins, \*Water potential.

Although plants are usually experimentally water-stressed by limited water availability to the root, they may also be stressed by increasing transpiration demands. Six-8 week old Nicotiana rustica plants were exposed for 30 minutes to an airstream. Subsequent tests showed that leaf cytokinin activity had been reduced as much as it decreased when roots were subjected to water stress. C-14-leucine roots were subjected to water stress. C-14-leucine uptake was also reduced in the stressed leaves and this reduction was not reversible by kinetin treatment. Cytokinin activity approached control levels after several hours in a humid chamber. Labelled kinetin distribution differed in stressed and non-stressed leaves. While changes in water potential transmitted to the roots may affect cytokinin synthesis, lowered levels in stressed detached leaves suggest molecular inactivation. (Casey-W71-08451

# THE EFFECT OF WATER STRESS ON IN-DOLEACETIC ACID OXIDASE IN PEA PLANTS.

Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.

Plant Physiology, Vol 47, No 1, p 65-67, Jan 1971. 2 fig. 1 tab, 14 ref.

Descriptors: \*Plant growth substances, \*Moisture stress, \*Biochemistry, Plant physiology, Laboratory tests, Colorimetry, Enzymes. Identifiers: \*Auxin, \*Seedlings.

It has been suggested that the presence of in-doleacetic acid (IAA) oxidase in plant tissue is a measure of the physiological age of the tissue. Pea plant (Pisum sativum) seedlings were subjected to -10atm water stress for 6 hours then returned to water to recover for a further 3 hours. Homogenate IAA oxidase fractions were determined by colorimetry and protein fractions by UV absorption. Two protein peaks were isolated. One peak was associated with the first IAA oxidase peak, and increased during water stress. The second peak could not be associated with an IAA oxidase peak and decreased after water stress. IAA oxidase was 116% of control in stressed plants, and surprisingly, 162% in recovered plants. Interpretation of the results requires further data. (Casey-Arizona) W71-08463

# ECO-PHYSIOLOGY OF WESTERN AUS-

TRALIAN PLANTS, Western Australia Univ., Nedlands. Dept. of

B. J. Grieve, and E. O. Hellmuth.

Occologia Plantarum, Vol 5, No 1, p 34-67, 1970. 4 fig, 3 tab, 68 ref.

Descriptors: \*Physiological ecology, \*Moisture stress, \*Arid lands, \*Xcrophytes, \*Plant physiology, Transpiration, Leaves, Stomata, Drought resistance, Photosynthesis, Plant morphology, Cuticles, Soil-water-plant relationships, Biological communities, Water loss, Heat resistance, Turgidity, Root systems, Soil types, Mode of action, Drought tolerance.

Identifiers: \*Western Australia, \*Sclerophylls. \*Adaptations, \*Water potential, \*Drought avoidance, Photosynthetic efficiency, Transpiration ratio, Root hairs.

## Field 02—WATER CYCLE

# Group 21—Water in Plants

Comparative accounts are given of 27 species of Western Australian native plants growing in vari-Western Australian native plants growing in various soil types in climatic regions varying from temperate to arid. A wide range of physiological variables were studied in relation to adaptive morphological structures in leaf types and root systems. Particularly important with reference to summer drought were water relations, heat resistance and photosynthetic efficiency. While drought avoidance was the commonest form of drought resistance, many drought tolerant forms were also present. Microphylly, vertical leaf orientation, sunken stomata, thick cuticles, hairs and shiny surfaces were common xeromorphic adaptashiny surfaces were common xeromorphic adaptations resulting in lowered leaf temperatures and reduced water loss. Common adaptive adjustments to water loss were increased reflectance, decreasing heat load and increased stomatal pathway resistance. Summer water loss was also significantly less in plants with tomentose leaves as opposed to glabrous leaves. Sunken stomata probably result in less photosynthesis reduction than transpiration reduction, resulting in a favorable transpiration ratio. Deep tap root systems occur in several species and are adaptations to drier conditions. The temperature tolerances of arid area plants are large and net photosynthesis temperature optima are higher. Saltbushes appear to be able to absorb moisture from a nearly saturated atmosphere. (Casey-Arizona) W71-08474

VEGETATION CHANGE FROM A SAND DUNE COMMUNITY TO A SALT MARSH AS RE-LATED TO SOIL CHARACTERS IN MARIUT DISTRICT, EGYPT,

Alexandria Univ. (Egypt). Dept. of Botany

Malak R. Rezk Oikos, Vol 21, No 2, p 341-343, 1970. 1 tab, 6 ref.

Descriptors: \*Dunes, \*Sands, \*Salt marshes, \*Halophytes, \*Soil alkalinity, Calcium carbonate, Vegetation, Ecosystems, Habitats, Sodium, Calcium, Soil moisture, Hygroscopic water, Biological communities, Soil salinity.

Identifiers: \*Egypt, \*Mediterranean climate,

\*Exchangeable sodium.

Salt marshes, with their characteristic halophyte plant communities, are found along the Mediterranean coast west of Alexandria wherever there are depressions. Between these and the coast itself are unstabilized sand dunes, which then grade into stabilized dunes, and farther south into salt marshes. Soil salinity and alkalinity varies in these different areas and an attempt was made to relate it to vegetation. The plant communities were described and soil chemical properties measured at 5 different points along a transect between coastal dunes and salt marshes. Exchangeable Ca decreased from unstabilized to stabilized dunes, then increased sharply in the marsh soil, probably reflecting the importance of Ca carbonate in semiarid soil particle stabilization. Soil hygroscopic moisture increased progressively from coastal dunes to marshes. Soil salinity was similar in the dune habitats and sharply increased in the marshes. In the dunes, plant species composition varied directly with stability. In the more stable areas, organic litter buildup facilititated the occurrence of new species. The very saline marshy areas supported glycophytes. (Casey-Arizona) W71-08475

FURTHER STUDIES OF EUROTIA LANATA GERMINATION IN RESPONSE TO SALINITY, Utah State Univ., Logan. Dept. of Range Science; and Utah State Univ., Logan. Ecology Center. For primary bibliographic entry see Field 03C. W71-08481

PRIMARY PRODUCTIVITY IN THE SANTA BARBARA CHANNEL, University of Southern California, Los Angeles.

Allan Hancock Foundation.

For primary bibliographic entry see Field 05C. W71-08778

OBSERVATIONS ON THE ZOOPLANKTON OF THE EASTERN SANTA BARBARA CHANNEL FROM MAY, 1969 TO MARCH, 1970, University of Southern California, Los Angeles.

Allan Hancock Foundation.

For primary bibliographic entry see Field 05C. W71-08779

SOME POLYCHAETOUS ANNELIDS FROM THE SANTA BARBARA SHELF AREA, University of Southern California, Los Angeles.

Allan Hancock Foundation.
For primary bibliographic entry see Field 05C.
W71-08781

NOTES ON SOME OPHIUROIDS FROM THE

SHELF OFF SANTA BARBARA, University of Southern California, Los Angeles.

Allan Hancock Foundation.
For primary bibliographic entry see Field 05C. W71-08782

IMBIBITION BY ALKALI SACATON SEEDS,

Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.
O. D. Knipe.

Journal of Range Management, Vol 24, No 1, Jan

1971, p 71-73.

Descriptors: \*Seeds, \*Range grasses, \*Absorption, \*Moisture uptake, Moisture content, Colorado. Identifiers: \*Seeds, \*Range grasses, \*Imbibition, \*Alkali sacaton, \*Seed-water-relations, Imbibition rate, Exudation losses.

Air-dry samples of large and small alkali sacaton (Sporobolus airoides Torr.) seeds were sandwiched between blotters saturated with distilled water and imbibed for various periods of time. After imbibiimbibed for various periods of time. After imbibi-tion the seeds were weighed and the percent of weight change (dry weight basis) was determined. Imbibition of water by the seeds progressed through three phases: (1) an initial period of rapid uptake lasting for approximately 4 hours, (2) a tapering-off period of slow or negative uptake (the large seeds actually lost weight during this period) that lasted approximately 7 hours in the large seeds and 2 hours in the small seeds, and (3) a period of gradual increase that lasted until sprouting occurred: the 28th hour in large and the 32nd hour in small seeds. The second stage apparently was due to exudation loss and possibly some loss of a mucilaginous membrane which envelops the seeds. The smaller seeds contain a greater proportion of the mucilage and thus imbibed more moisture and at a higher rate than the large seeds. W71-08843

LIGHT DELAYS GERMINATION OF ALKALI SACATON.

Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo. O. D. Knipe

Journal of Range Management, Vol 24, No 2, p 152-154, Mar 1971.

Descriptors: \*Seeds, \*Range grasses, \*Germina-

tion, \*Light, New Mexico.
Identifiers: \*Seeds, \*Range grasses, \*Germination,
\*Light effects, \*Alkali sacaton, Light-germination-

To determine if alkali sacaton is negatively photoblastic, seeds were placed in black petri dishes on moist blotters and allowed to imbibe moisture for 30 min at 90F. After imbibition the seeds were subjected to light treatment of 1000 ft-c intensity for periods ranging from flash to constant exposure. Exposure of alkali sacaton seeds to light for a few seconds after imbibition delayed germinaa tew seconds after infibition delayed germina-tion 24 hr, exposure for 9 to 13 hr delayed germina-tion 28 hr, exposure for more than 13 hr delayed germination 72 hr and continuous exposure reduced germination 40 percent. IMPROVING SURVIVAL OF ALKALI SACATON SEEDLINGS UNDER ADVERSE CONDITIONS,

Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

Earl F. Aldon.

USDA Forest Serv Res Note RM-177. 3 p.

Descriptors: \*Erosion control, \*Vegetation effects, \*Watershed management, \*Soil stabilization, Vegetation establishment, New Mexico, Germina-

Identifiers: Plant establishment, Floodplain stabilization.

Alkali sacaton (Sporobolus airoides (Torr.) Torr.) seedlings have little chance of surviving adverse field conditions unless seeds are planted on moist soil, on an agar plate, under mulch, and watered after 5 days. W71-08850

A COMPARISON OF SEVERAL STATISTICAL MODELS IN FOREST BIOMASS AND SUR-FACE AREA ESTIMATION,

Southeastern Forest Experiment Station, Asheville,

Hans T. Schreuder, and Wayne T. Swank. In: Forest Biomass Studies, Misc Pub 132, Life Sci and Agr Exp Sta, Univ of Maine at Orono, p 125-136, 1971. 2 fig, 3 tab, 14 ref.

Descriptors: \*Statistical models, \*Biomass, \*White pine trees, \*Regression analysis, North Carolina, Vegetation, Leaves, Estimating, Mathematics, Sur-

Identifiers: Coweeta Hydrologic Laboratory.

The squared correlation and log likelihood techniques are discussed and used to evaluate statistical estimation models for eastern white pine biomass and surface area data. Three a priori linear models are considered: (1) an unweighted untransformed model, (2) a weighted untransformed model, and (3) a log-log transformation model. In addition, a comprehensive model is considered which includes two of the a priori models and other standard models as special cases. The likelihood approach is demonstrated to be a useful statistical approach is definitional to be a defut statistical tool for comparing dimensional tree component models. The R sq criteria can be misleading. Specifically R sq gave misleading results in selecting the unweighted untransformed model over the weighted untransformed model in five out of eight cases. Considering only the a priori models, the biomass parameters would be estimated by the loglog transformation and the weighted linear models would be used for the surface area parameters. The double square root transformation appears to be a promising alternative model. W71-08858

#### 2J. Erosion and Sedimentation

SWASH ZONE PROCESSES: AN EXAMINA-TION OF WATER MOTION AND THE RELA-TIONS BETWEEN WATER MOTION AND FORESHORE RESPONSE ON SOME MIXED SAND AND SHINGLE BEACHES, KAIKOURA, NEW ZEALAND, Robert M. Kirk.

Coastal Research Notes, Vol 3, No 4, p 1-3, Mar 1971. 3 p, 1 ref.

Descriptors: \*Beaches, \*Subsurface investigations, \*Sedimentology, \*Geomorphology, Sediment transport, Groundwater movement, Soil water movement, Sands, Ocean waves, Flow characteristics, Instrumentation, Analytical techniques, Tidal effects, Data collections, Particle size. Identifiers: Backwash, Swash zone.

Processes responsible for the production and modification of morphological and sedimentological changes on the subacrial beach face were investigated on some mixed sand and shingle beaches, Kaikoura, New Zealand. An instrument

## Erosion and Sedimentation—Group 2J

system was constructed for the measurement of flow speeds, pressures, asymmetries, depths, levels of groundwater storage and outflow, and of flow durations. In association with the observations of these flow processes several responses to flow regime were also sampled. These included alterations to grain size parameters of bed sediments, transport rates of solids in the swash and backwash, vertical distributions of sediment in both swash and backwash, and changes in bed elevation. An electro-mechanical force plate dynamometer was employed for the measurement of flow speed, force, power and duration and a small parallel wire gage sensed depth fluctuations in swash and backwash flows. The output from both of these units was recorded on a strip chart for later analysis. A wide range of breaker heights, periods and types is received at four stations. More than 3,000 in-dividual measurements of swash/backwash flow conditions were obtained from these four profiles for breaker heights of from 1.5 to 10.0 feet and for breaker periods ranging from 7.5 to 11.0 seconds. (Woodard-USGS)
W71-08325

TRANSPORT AND DISPERSION OF FLUORESCENT TRACER PARTICLES FOR THE FLAT-BED CONDITION, RIO GRANDE CONVEYANCE CHANNEL, NEAR BERNARDO, NEW MEXICO, Geological Surgest. March 1987.

Geological Survey, Washington, D.C. R. E. Rathbun, V. C. Kennedy, and J. K.

For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC, 20402, Price \$0.65. Geological Survey Professional Paper 562-1, 1971. 56 p, 42 fig, 19 tab, 25 ref, 3 ap-

Descriptors: \*Sediment transport, \*Tracers, \*Fluorescence, \*Rio Grande, \*New Mexico, Analytical techniques, Weirs, Correlation analysis, Alluvial channels, Sediment distribution, Sedimentation rates, Channel morphology, Particle size,

Sedimentology.
Identifiers: \*Bernardo (N Mex), \*Flat-bed channel, Conveyance channel, Fluorescent tracers.

A fluorescent tracer technique was applied to a study of the rates of transport and dispersion of sediment particles of various diameters and specific gravities for the high-velocity flat-bed conditions of alluvial-channel flow. Two runs were conducted in the Rio Grande conveyance channel near Bernardo, New Mexico, on December 13 and 14, 1966. An instantaneous point source of fluorescent material was used in each run. Samples of the bed material moving on or near the bed surface were obtained throughout the passage of the tracer masses with the 'dustpan' sampler especially designed for this study. The sediment-transport rates calculated from the fluorescent tracer experiments were about 57 and 14 percent larger than the sediment-transport rates measured at the weir in runs 1 and 2, respectively. The agreement in run 2 was good because positive and negative errors for the different sieve classes were compensating. (Woodard-USGS) W71-08328

HYDROLOGY OF QUATERNARY DELTA DEPOSITS OF THE MISSISSIPPI RIVER,

Geological Survey, Baton Rouge, La. Paul H. Jones.

In: Hydrology of Deltas, Vol 1, Proceedings of the Bucharest Symposium, May 1969, International Association of Scientific Hydrology Publication No 90, p 49-63, 1970. 15 p, 9 fig, 30 ref.

Descriptors: \*Deltas, \*Mississippi River, \*Sedimentation, \*Strategraphy, Deposition (Sediments), Paleohydrology, Hydrogeology, Runoff, Alluvial channels, Saline waters, Saline water systems, Saline water intrusion, Water quality, Water chemistry, Water resources development. Identifiers: Mississippi Delta.

Quaternary delta deposits of the Missisiippi River, together with interbedded marine sediments, have a cumulative maximum thickness greater than 13,000 feet, of which the delta deposits constitute perhaps half. They underlie a coastal belt some 300 miles in length, and extend more than 150 miles southward from the coastline of southwestern Louisiana beneath the Gulf of Mexico. The late Quaternary deltaic mass contains almost no fresh groundwater, although streams that cross it carry runoff from 60% of the conterminous United States. This seeming paradox is caused by expulsion of saline waters from incompetent prodelta clay beds overridden by advancing deltaic sediments having a common framework and parent trunkstream source. Distributary channel deposits terminate gulfward in marine clay and join headwards with those of the trunk stream to form an integrated system of conduits, through which water expelled from compacting sediments is discharged upvalley. Because the delta is still growing, this discharge is continuing. It causes landward movements of saline groundwater, threatens some existing fresh-water supplies, and must be considered carefully in any developments of fresh-water resources in the delta. (Knapp-USGS) W71-08343

SOME ASPECTS OF EROSION AND SEDIMENTATION IN AN ARCTIC DELTA DURING

Louisiana State Univ., Baton Rouge, and Office of Naval Research, London (England).

Also published as Louisiana State Univ. Coastal Studies Inst. Technical Report no 90, Nov 1970. In: Hydrology of Deltas, Vol 1, Proceedings of the Bucharest Syposium, May 1969, International As-sociation of Scientific Hydrology Publication no 90, p 209-219, 1970. 11 p, 19 fig, 15 ref. Contract no N00014-69-A-0211-0003, Project no 388 002 of the Geography Programs, ONR.

Descriptors: \*Sediment transport, \*Ice breakup, \*Deltas, \*Alaska, \*Artic Ocean, Rivers, Lake icc, Erosion, Sedimentation, Sediment distribution, Permafrost, Melt water, Ablation, Streamflow. Identifiers: \*Colville River (Alaska).

In arctic deltas, the character and amount of ero-sion and sedimentation are affected by numerous factors not normally operating in other deltas. A long period of snow and ice cover, continous permafrost, a thin active layer and extreme variation in discharge are among some of the more important conditions involved. The Colville River, which drains much of arctic Alaska, has nearly half of its discharge and some three-fourths of its sediment load concentrated into the three- to four-week period accompanying and immediately following breakup. During this period thermoerosional niches form in the frozen riverbanks. The undercutting is frequently responsible for bank collapse and rapid bank retreat. Likewise, the bulk of the delta's deposition occurs during this short period of time. As sediment is deposited on bottom-fast river ice and on the sea at the front of the delta, much of it is often lost to the delta during breakup. (Woodard-USGS)
W71-08344

TRANSPORT PROCESSES OF PARTICLES IN DILUTE SUSPENSIONS IN TURBULENT WATER FLOW - PHASE I,

Illinois Univ., Urbana. Water Resources Center. For primary bibliographic entry see Field 08B. W71-08492

RECOVERY OF MICA FROM SILT DEPOSITS IN THE NOLICHUCKY RESERVOIR, TENNES-

Bureau of Mines, Tuscaloosa, Ala. Tuscaloosa Metallurgy Research Center. For primary bibliographic entry see Field 05D.

FORMATION OF SULFUR-BEARING MUDS IN RECENT CRATER LAKES, (RUSSIAN: USLOVIYA OBRAZOVANIYA SERONOSYNKH ILOV V SOVREMENNYKH KRATERNYKH OZERAKH),

Gosudarstvennyi Nauchno-Issledovatelskii Institut Gornokhimicheskogo Syrya, Lyubertsii (USSR); Gornokhimicheskogo Syrya, Lyubertsii (USSR); and Akademiya Nauk SSR, Moscow. Institut Geok-himii i Analitcheskoi Khimii. For primary bibliographic entry see Field 02H. W71-08538

IRRIGATION PRACTICES AND IRRIGATION EROSION OF SOILS, (RUSSIAN: TEKHNIKA POLIVA I IRRIGATSIONNAYA EROZIYA POCHV),

For primary bibliographic entry see Field 03F. W71-08585

TRANSPORT AND DEPOSITION OF FLOOD SEDIMENT, SANTA BARBARA CHANNEL, CALIFORNIA, University of Southern California, Los Angeles.

Dept. of Geological Sciences.
For primary bibliographic entry see Field 05C.
W71-08797

HYDROCARBON CONTENT OF SANTA BAR-BARA CHANNEL SEDIMENTS, University of Southern California, Los Angeles.

Dept. of Geological Sciences; and Cincinnati Univ., Ohio. Dept. of Chemistry; and Gulf General Atomic Co., San Diego, Calif. For primary bibliographic entry see Field 05C. W71-08799

GENERAL CHARACTERISTICS OF NEARSHORE SEDIMENTS FROM EL CAPITAN TO VENTURA, CALIFORNIA, 1969-1970. University of Southern California, Los Angeles. Dept. of Geological Sciences. For primary bibliographic entry see Field 05C. W71-08800

STREAM SEDIMENT: AN ENVIRONMENTAL

PROBLEM,
Geological Survey, Washington, D.C. Water Resources Div.

For primary bibliographic entry see Field 04C. W71-08821

PRINCIPAL COMPONENTS ANALYSIS OF WATERSHED VARIABLES AFFECTING AFFECTING SUSPENDED SEDIMENT DISCHARGE AFTER

A MAJOR FLOOD,
Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
Henry W. Anderson.

Symposium on the Results of Research on Representative and Experimental Basins. Interna-tional Association of Scientific Hydrology Publication No 96: 404-416, 1970.

Descriptors: \*Erosion, \*Suspended load, \*Watershed management, \*Analytical techniques, \*Accelerated erosion, Lumbering, Regression analysis, Watersheds, Variability, Geomorphology, Topography, Drainage patterns (Geologic), Channels, Geologic control, Land use, Grasslands, Highways, Slope stability, California. Identifiers: \*Mountain watersheds, Logging, Multivariate analysis Fluw paths.

tivariate analysis, Flow paths.

Suspended sediment discharge from 31 watersheds after two major floods in northern California exceeded pre-flood amounts by as much as 5 times. Increases the first year after the 1964 flood ranged from 0 to 7300 metric tons per square kilometer (21000 tons per square mile). Increased sediment discharge from watersheds depended on the relative size of flood, topography, and land use in each watershed. Poor land-use practices-specifically, placing logging roads adjacent to streams and temporary log storage areas (landings) in draws-was

# Field 02—WATER CYCLE

# Group 2J—Erosion and Sedimentation

associated with 70 percent greater increases in associated with 70 percent streets as seen as a second street as a second stre lated the decline of sedimentation to the year since each flood. Second year increases averaged 94 percent of first year. By the third year increases had declined to 66 percent of the first year increases. The amount and duration of increases in sediment discharge associated with changes brought about by large floods will affect watershed management decisions and programs requiring estimates of long-term sedimentation from watersheds. W71-08837

CHARACTERISTICS AND PROCESSES OF SOIL PIPING IN GULLIES,

Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo. Burchard H. Heede.

USDA Forest Serv Res Pap RM-68, 1971. 15 p, il-

Descriptors: \*Gullies, \*Soil erosion, \*Permeability, Soil stabilization, Colorado.

Identifiers: Exchangeable Sodium Percentage.

Soil piping processes and soil development were studied as a result of combined pipe and gully acstudied as a control of control pipe and gany ac-tions. Soils from gully side slopes with and without pipes showed a highly significant difference in exchangeable sodium percentage (ESP). Piping soils had a layer permeability 2 to 12 percent of that of soils without pipes. Both soils were fine texture. The interior of one soil pipe was thoroughly inspected, surveyed, and photographed from inlet to outlet. Based on the survey, and chemical and mechanical analyses, it is proposed that soil pipes on the Alkali Creek watershed developed mainly from soil cracks. Other causes such as rodent holes or dead root canals are presumed possible, but were not verified. Gullies, high exchangeable sodium percentage, low gypsum content, and fine-textured soils with montmorillonite clay appear to be prerequisites to the formation of soil pipes on the study area. ESP was significantly higher in piping soils in place than in those fallen from the gully side ESP decreased also with increasing time since fall. Natural reclamation of the fallen soils led to processes initiating gully stabilization. W71-08842

# MEASUREMENT OF CREEP IN A SHALLOW,

SLIDE-PRONE TILL SOIL,
Pacific Northwest Forest and Range Experiment
Station, Juneau, Alaska. Inst. of Northern Forestry.
D. J. Barr, and D. N. Swanston.

American Journal of Science, Vol 269, p 467-480, Dec 1970. 5 fig, 2 tab, 5 ref.

Descriptors: \*Creep, \*Soil mechanics, \*Slope stability, \*Soil dynamics, Clear-cutting, \*Landslides, \*Glacial soils, Mass wasting, Soil crosson, Engineering geology, Soil engineering, Soil physical properties, Alaska.

Identifiers: Southeast Alaska, Logged areas, Strain

Strain probe measurements of creep in a steep glacial till soil were made in an area of active soil movement in southeastern Alaska. Estimates of creep indicate rates in excess of 0.06 m per year at the surface, rapidly decreasing to zero at an im-permeable lower soil boundary. The soil apparently moves as a flow mass with no well-defined shear zones. Inferences from probe data and deformation of paraffin rods installed in active slopes suggest that movement exists the year round with the highest rate of movement occurring in the fall and spring when soil moisture is highest.

#### SEDIMENT MOVEMENT IN A POOL AND RIF-FLE STREAM,

North Central Forest Experiment Station, St. Paul,

Edward A. Hansen.

International Symposium on the Results of Research on Representative and Experimental Basins, Wellington, New Zealand, Dec 1-8, 1970, IASH-VNESCO Pub 96, p 541-561, illus.

Descriptors: \*Sediment transport, \*Sediment discharge, \*Particle size, \*Bank erosion, \*Bed load, Sediment load, Sediment yield, Stream erosion, Bottom sediments, River beds, Scour, Deposition (Sediments), Michigan.
Identifiers: \*Sediment sampling, \*Total sediment load.

A sediment budget was constructed for a pool and riffle stream along which eroding streambanks were the dominant sediment source. Total sediment load was measured with a DH-48 sediment sampler at artificial sills placed on the streambed at each of the five sampling stations, which eliminated an 'unsampled zone'. Supplementary data collected at each station and an independent check with a long-term reservoir fill rate indicated the 'sill samples' were accurate measures of total load for a wide range of sampling site hydraulic charac-teristics. The total load data were used to deter-mine the impact of eroding bank sediments on both sediment load and streambed composition. Total load increased 530 percent along a 26-mile (42 kilometers) section of main channel; most of this increase came from eroding streambanks. How-ever, particle-size distribution of the predominantly sand-size sediment load remained the same along the section of stream. The proportion of streambed area in sand decreased downstream, while the pro-portion in cobble and boulder increased -- an apparent result of increased stream gradient. Although sediment load was related to stream discharge, it was believed to be dependent upon sediment delivery rate to the stream.

# DEPOSITION OF SEDIMENT IN TRANSIENT

W71-08862

South Dakota State Univ., Brookings. Dept. of Civil Engineering; and Federal Highway Administration, Kansas City, Kans. Kansas Div.
Fred F. M. Chang, and Dennis L. Richards.
Supported by National Science Foundation and South Dakota Water Resources Institute. ASCE

Proceedings, Journal of the Hydraulics Division, Vol 97, No HY6, Paper 8191, p 837-849, June 1971. 13 p, 4 fig, 1 tab, 14 ref, append. Project 3,569 SRI.

Descriptors: \*Sediment transport, \*Unsteady flow, \*Deposition (Sediments), \*Mathematical models, \*Computer programs, Slopes, Alluvial channels, Suspended load, Bed load, Equations, Estuaries, Tidal effects, Numerical analysis. Identifiers: Transient flow.

An analytical method of predicting the change in reiverbed elevation at transient phases is developed. A computer program is presented so that a sample computation can be made to check the stability and convergency of the method. For channels in which the sediment-laden water can be considered completely homogeneous and in which the velocity can be considered uniform over the cross section, equations of continuity and the equation of motion of sediment-laden water presented. Introducing the assumption that the dif-ference between the original bed slope and the new bed slope within a short period is very small, these three basic partial differential equations are successfully reduced to two partial differential equations. The method of characteristics is then employed to solve for the mean velocity and the mean depth of flow. In order to estimate the sediment deposit thickness, the equation of continuity for sediment is transformed directly to finite-difference form. (Knapp-USGS) W71-08908

# THE DEGRADATION OF LIAS CLAY SLOPES IN AN AREA OF THE EAST MIDLANDS,

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering. Richard John Chandler.

Quarterly Journal of Engineering Geology, Vol 2, No 3, p 161-176, February 16, 1970, 16 p, 7 fig, 3 plate, 14 ref, append.

Descriptors: \*Landslides, \*Clays, \*Soil mechanics, Soil strength, Till, Groundwater, Geology, Hydrogeology, Degradation (Stream), Geomorphology, Consolidation.

Identifiers: Rutland (England), Northamptonshire

A sequence of slope degradation was studied in an area in Rutland and Northamptonshire, England, where a more rigid layer generally overlies a thick deposit of fissured, heavily over-consolidated clay. The capping of Inferior Oolite or boulder clay is locally associated with relatively steep slopes in the Upper Lias Clay with the consequence that shallow rotational slides have developed. The limiting angle of slope on which movement has occurred is about 9 deg and the maximum stable slope is 10 1/2 deg. Because of the comparative freshness of the land-slide topography the virtual complete absence of such features as ungrassed scarps is unusual. Apparently, degradation is taking place only very slowly under present climatic conditions; asymmetrical valleys which have slides developed on their the ranks which have sinces developed on their steeper southern slopes suggest that some of the movements may date back to the periglacial conditions of the Late Glacial period. (Knapp-USGS) W71-08929

#### 2K. Chemical Processes

WATER RESOURCES DATA FOR COLORADO, 1969: PART 2. WATER QUALITY RECORDS. Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 07C. W71-08324

HYDROLOGY OF QUATERNARY DELTA DEPOSITS OF THE MISSISSIPPI RIVER, Geological Survey, Baton Rouge, La. For primary bibliographic entry see Field 02J. W71-08343

ISOTOPE COMPOSITION OF UNDERGROUND ISOTOPE COMPOSITION OF UNDERGROUND BRINES AS AN INDICATOR OF THEIR ORIGIN (RUSSIAN: OB IZOTOPNOM SOSTAV PODZEMNYKH RASSOLOV KAK POKAZATELE IKH PROISKHOZHDENIYA), Institut Prirodnogo Gana. Moscow (USSR). For primary bibliographic entry see Field 02F.

ISOTOPE COMPOSITION OF URANIUM (U-234, U-238) IN WATERS AND BOTTOM SEDI-MENTS OF LAKE BALKHASH, AND AGE OF THE LAKE (RUSSIAN: IZOTOPNYY SOSTAV URANA (U-234, U-238) V VODAKH I DON-NYKH OSADKAKH OZ. BALKHASH I PRO-DOLZHITEL'NOST' SUSHCHESTVOVANIYA VODOYEMA),

Akademiya Nauk Kirghiz SSR, Frunze. Inst. of Physics and Mathematics. For primary bibliographic entry see Field 02H. W71-08368

REACTIONS OF A STRONGLY BASIC ION EXCHANGE RESIN WITH DILUTE AQUEOUS SOLUTIONS IN A COLUMNAR SYSTEM, Michigan Univ., Ann Arbor. Div. of Sanitary and Water Resources Engineering. For primary bibliographic entry see Field 05D. W71-08391

#### GOLD CONTENT OF NATURAL WATERS IN COLORADO,

Geological Survey, Helena, Mont. A. W. Gosling, E. A. Jenne, and T. T. Chao. Economic Geology, Vol 66, No 2 p 309-313, Mar-Apr, 1971. 4 p, 1 fig, 2 tab, 7 ref.

### Chemical Processes—Group 2K

Descriptors: \*Gold, \*Geochemistry, \*Neutron activation analysis, \*Water chemistry, Neutron absorbtion, Analytical techniques, Hydraulic mining, sorbtion, Analytical techniques, Hydraulic mining, Placer mining, Chemical analysis, Colorado, Rocky Mountain region, Mine drainage, Waste dumps, Spectroscopy, Aqueous solutions, Chemical precipitation, Dispersion, Solvent extractions. Identifiers: \*Idaho Springs (Colo), \*Clear Creek (Colo), Gold concentrations (Natural waters), \*Hydrogeochemical gold prospecting.

Neutron activation analysis of 67 samples of water draining from gold-barren and gold-enriched sedimentary, igneous, and metamorphic rocks of the Colorado Front Range reveals a relatively small range in total gold content (nondetectable to 150 nanograms per liter). 'Solute' gold concentrations were generally higher than particulate gold concentrations and both were unrelated to rock or water types. The data suggest the occurrence of a spring flush out of 'solute' gold in groundwater discharge during the snow-melt recharge period but indicate that direct hydrogeochemical prospecting for gold is unpromising. (J. Glasby-USGS) W71-08518

PECULIARITIES IN THE GEOCHEMISTRY OF CESIUM IN GROUNDWATER OF VARIOUS DEEP ZONES OF THE EARTH'S CRUST (RUSSIAN: OSOBENNOSTI GEOKHIMII TSEZIYA V PODZEMNYKH VODAKH RAZLICHNYKH GLUBINNYKH ZON ZEMNOY KORY), All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR). S. R. Kraynov.

S. R. Kraynov. Geokhimiya, No 8, p 979-987, Aug 1970. 9 p, 4 fig, 4 tab, 18 ref.

Descriptors: \*Geochemistry, \*Cesium, \*Water chemistry, Groundwater, Magmatic water, Alkali metals, Pegmatites, Potassium, Hydrogeology.

Identifiers: \*USSR, Greater Caucasus, Hydrogeochemistry, Magmatism.

A varying rate of cesium migration was determined for waters of different horizons of the earth's crust. Cesium is most mobile in carbonate and termal waters of regions of recent and Late-Quaternary magmatism. In the Greater Caucasus the cesium concentration increases as areas of carbonate thermal waters approach foci of Late-Quaternary magmatism. In groundwaters of the supergene zone cesium is the least mobile of alkali elements. Of the rare alkali elements, cesium exhibits the widest range of differences in migration capacities for upper and lower horizons of the earth's crust. (Josefson-USGS) W71-08537

RADIOACTIVE ELEMENTS AND DEUTERIUM IN GROUNDWATERS OF THE BUKHARO-KARSHINSKIY ARTESIAN BASIN (RUSSIAN: RADIOAKTIVNYYE ELEMENTY I DEYTERIY V PODZEMNYKH VODAKH BUKHARO-KARSHINSKOGO ARTEZIANSKOGO BAS-SEYNA).

Akademiya Nauk SSR, Moscow. Inst. of Water Research; and Vsesoyuznyi Nauchno-Issledovatel-skii Institut Yadernoi Geofiziki i Geokhimii, Moscow (USSR).

F. A. Alekseyev, R. P. Gottikh, V. N. Soyfer, and V. S. Brezgunov.

Geokhimiya, No 12, p 1483-1494, Dec 1970. 12 p,

Descriptors: \*Radioactive dating, \*Uranium radioisotopes, \*Radium radioisotopes, \*Deuterium, \*Geologic time, Groundwater, Mesozoic era, Recent epoch, Infiltration, Sedimentation, Geochemistry.
Identifiers: \*USSR, \*Kazakhstan, Amu Darya

River, Sedimentation waters, Jurassic period, Cretaceous period.

The distribution of uranium, radium, and deuterium in groundwaters of a Mesozoic cross section of the Bukharo-Karshinskiy artesian basin reflects a

change in the geochemical state of the waters, with a definite correlation between radium and deuterium content. Data on uranium, radium, and deuterium content in combination with data on the geological structure of the basin show that the present character of the groundwaters of the basin show that the present character of the groundwaters of the basin show the Mosey of the Mose is the result of two infiltration periods--the Mesozoic and the recent one--and make it possible to determine zones of infiltration water intrusion and the degree to which connate waters are diluted by them. Data on uranium, radium, and deuterium content in waters of Jurassic, Lower Cretaceous and Cenomanian-Albian water bearing complexes point to the connate nature of waters and to excelent isolation of the complexes from one another. From the content of radioactive elements and deuterium it is possible to solve problems of water genesis, determine the direction of flow of infiltration waters and to assess the extent of their supply. (Josefson-USGS) W71-08539

LITHIUM, RUBIDIUM AND CESIUM ABUNDANCE IN WATERS AND SOLID EJECTAMENTA OF MUD VOLCANOES OF THE KERCH-TAMAN REGION (RUSSIAN: RASPROSTRANENIYE LITIYA, RUBIDIYA I TSEZIYA V VODAKH I TVERDYKH VYBROSAKH GRYAZEVYKH VULKANOV KERCHENSKO-TAMANSKOY OBLASTI), Veesevurtui Neftronoi Naucho Jesiedovatelskii

Vsesoyuznyi Neftyanoi Nauchno-Issledovatelskii Geolograzvedochnyi Institut, Leningrad (USSR). I. A. Khod'kova, and S. D. Gemp. Geokhimiya, No 12, p 1495-1503, Dec 1970. 9 p, 2

Descriptors: \*Volcanoes, \*Alkali metals, \*Cesium, \*Trace elements, \*Geochemistry, Boron, Strontium radioisotopes, Geologic time, Brines, Clays. Identifiers: \*USSR, \*Crimea, Kerch Strait, Lithium, Rubidium, Barium, Ejectamenta, Breccia.

The solid ejectamenta of mud volcanoes of the Kerch-Taman' region are shown to contain large amounts of lithium, rubidium, boron, barium, strontium and other elements as compared with the sedimentary rocks developed outside the zone of mud volcano influence. Waters of the mud volcanoes contain 10-100 times more lithium, rubidium, cesium and boron than those of the world's oceans. In waters and breccia of two volcanoes in particular--the Shugo and Gladkovskiy--lithium, rubidium and cesium content is 3-5 times that of other volcanoes. Generally, waters and gases of the mud volcanoes of the region take an active part in forming the chemical composition of natural brine of lakes of the Kerch Peninsula and of Kerch iron ores of the Cimmerian age. (Josefson-USGS). W71-08540

URANIUM, THORIUM AND RARE-EARTH ELEMENTS IN THERMAL WATERS OF KAMCHATKA (RUSSIAN: URAN, TORIY I REDKOZEMEĽNYYE ELEMENTY V TERMAĽNYKH VODAKH KAMCHATKI), Institut Vulkanologii, Petropavlovsk-Kamchatskii

(USSR).

N. I. Udal'tsova, and L. L. Leonova. Geokhimiya No 12, p 1504-1510, Dec 1970. 7 p, 2 tab, 24 ref.

Descriptors: \*Thermal water, \*Geochemistry, \*Uranium radioisotopes, Chlorides, Sodium, Sulfates, Rocks, Acidic water, Igneous rocks.
Identifiers: \*USSR, \*Kamchatka, Thorium, Rare-

earth elements.

The contents of uranium, thorium and rare-earth elements in chloride-sodium carbonate, sulfatechloride-sodium carbonate, sulfate and carbonate thermal waters of Kamchatka were determined with an error of plus or minus 25-30%. Thorium: uranium and rare-earth: thorium ratios are calculated. Minimum concentrations of uranium, thorium and rare-earth elemets are found in deep chloride-sodium carbonate thermal waters. In sulfate waters the uranium concentration increases

twofold and that of thorium and rare-earth elements 10- and 5- fold, respectively. It is assumed that uranium, thorium and rare-earth elements are present in a dissolved state in all types of waters and that country rocks are the source of these elements in the waters. A change in the chemistry of chloride-sodium carbonate and carbonate waters has no significant effect on the uranium concentration in them. The determining factor in this case is the low uranium content in the volcanogenic rocks of Kamchatka. Studies do not solve the problem of the juvenile component for iranium, thorium and rare-earth elements in thermal waters but its fraction is undoubtedly very small. (Josefson-USGS) W71-08541

#### BIOGEOCHEMISTRY OF A RESERVOIR ECOSYSTEM.

ECOSYSTEM,
Oklahoma State Univ., Stillwater. Dept. of Chemistry; and Oklahoma State Univ., Stillwater. Dept. of
Zoology; and Oklahoma State Univ., Stillwater.
Reservoir Research Center.
For primary bibliographic entry see Field 05A.
W71-08685

# THE APPLICATION OF NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY TO PESTICIDE ANALYSES.

Environmental Protection Agency, Athens, Ga. Southwest Water Lab. For primary bibliographic entry see Field 05A. W71-08833

# THE ENHANCEMENT OF ASYMMETRY EFFECTS IN NMR BY INTERMOLECULAR HYDROGEN BONDING,

Environmental Protection Agency, Athens, Ga. Southwest Water Lab. For primary bibliographic entry see Field 05A. W71-08834

# EU (DPM)3 TRANSANNULARLY INDUCED PARAMAGNETIC CHEMICAL SHIFTS IN THE PMR SPECTRA OF ENDRIN, DIELDRIN, AND PHOTODIELDRIN,

Environmental Protection Agency, Athens, Ga. Southwest Water Lab.

For primary bibliographic entry see Field 05A. W71-08835

#### LONG-RANGE COUPLINGS IN THE CHLORINATED POLYCYCLODIENE PESTI-CIDES.

Environmental Protection Agency, Athens, Ga. Southwest Water Lab.

For primary bibliographic entry see Field 05A. W71-08836

# SURFACE SALINITY AND TERMPERATURE 'SIGNATURES' IN THE NORTHEASTERN PACIFIC.

Scripps Institution of Oceanography, La Jolla, Calif

Martha W. Evans.

Journal of Geophysical Research, Vol 76, No 15, p 3456-3461, May 20, 1971. 6 p, 5 fig, 1 tab, 9 ref. ONR Contract N000 14-69-A-0200-6006.

Descriptors: \*Water temperature, \*Salinity, \*Pacific Ocean, Sea water, Water chemistry, Sampling, Surveys, Data collections, Bathythermographs. Identifiers:

Salinity-temperature relations (Pacific).

In general, sea-surface temperatures increase to a maximum toward the equator, and surface salinity reaches a maximum in the subtropics. Surface waters may be roughly classified into areas where temperature and salinity are positively correlated and areas where they are negatively correlated. Continuous-record data show that the transitions from one regime to the other take place abruptly in

## Field 02-WATER CYCLE

# **Group 2K—Chemical Processes**

some regions. In addition, the continuous records of salinity and temperature provide a means of immediately recognizing positions of oceanic fronts and advective phenomena. (Knapp-USGS) W71-08913

#### 2L. Estuaries

ESTUARINES, BAYS AND COASTAL CUR-RENTS AROUND PUERTO RICO, Puerto Rico Univ., Mayaguez. School of Engineer-

For primary bibliographic entry see Field 05B. W71-08322

# HYDROBIOLOGICAL CHARACTERISTICS OF SHARK RIVER ESTUARY, EVERGLADES NATIONAL PARK, FLORIDA,

Geological Survey, Tallahassee, Fla.
Benjamin F. McPherson.
Geological Survey Open-file Report 71002
(Florida), Dec 1970. 113 p, 19 fig, 18 tab, 26 ref,

Descriptors: \*Wetlands, \*National Parks, \*Florida, Descriptors: \*Wetlands, \*National Parks, \*Florida, \*Estuaries, \*Water quality, Water level fluctua-tions, Water pollution effects, Droughts, Produc-tivity, Wet seasons, Marshes, Swamps, Aquatic en-vironment, Dissolved oxygen, Salinity. Identifiers: \*Everglades National Park (Fla).

Water quality in the Shark River estuary, Everglades National Park, Florida, is strongly influenced by seasonal patterns of rainfall, water level, and temperature. During the rainy season (summer and early fall) the salinity in the 20-mile long estuary ranges from that of fresh water to half that of fear water while concentrations of disclosed. that of sea water while concentrations of dissolved oxygen are low, 2-5 milligrams per liter. During the dry season (late fall through spring) the salinity ranges from 18 grams per liter (g/l) in the headwaters to 36 g/l at the Gulf during a dry year such as 1967 and from 1 to 25 g/l during a wet year such as 1969. The patterns of distribution of planktonic and small nektonic animals in the estuary are related to salinity. The presence of large numbers of juvenile and young animals indicate the importance of these brackish waters as nursery grounds. Small fish and prawns, which concentrate in the headwaters as the water level dropped, serve as a rich source of food for predatory marine fish and birds. (Knapp-USGS) W71-08329

#### SPARTINA 'DIE-BACK' IN LOUISIANA

MARSHLANDS, Louisiana State Univ., Baton Rouge. Coastal Studies Inst.

For primary bibliographic entry see Field 05C. W71-08348

# RECOVERY OF SALT MARSH IN BRITTANY SIXTEEN MONTHS AFTER HEAVY POLLU-TION BY OIL,

Nature Conservancy, Norwich (England). Coastal Ecology Research Station.

For primary bibliographic entry see Field 05C. W71-08600

# STUDIES OF THE NATURAL ALPHA-EMITTING RADIOISOTOPES IN MARINE OR-

Washington, Univ., Seattle. For primary bibliographic entry see Field 05C. W71-08654

# OBSERVATIONS ON THE SMALL-SCALE DISTRIBUTION OF ESTUARINE PHYTOPLANK-

Maine Univ., Walpole. Ira C. Darling Center for Research; and Maine Univ., Walpole. Dept. of

For primary bibliographic entry see Field 05C.

W71-08677

# STRATIFICATION AND MIXING IN COASTAL WATERS OF THE WESTERN GULF OF MAINE DURING SUMMER,

Woods Hole Oceanographic Institution, Mass.

Edward M. Hulburt.

Journal Fisheries Research Board of Canada, Vol 25, No 12, p 2609-2621, 1968. 6 fig, 8 ref. AEC Contract AT (30-1)-1918.

Descriptors: \*Sea water, \*Temperature, \*Fog, \*Stratification, \*Mixing, Solar radiation, Gulfs, Tidal effects, Winds, Thermal stratification, Weather, Currents (Water), Maine.

Identifiers: \*Gulf of Maine, Coastal waters, Bay of Fundy, Casco Bay (Maine).

The low temperatures (between 11C and 13C) of surface water along the western coast of the Gulf of Maine indicate an active vertical mixing of water layers associated with tidal currents. High temperatures of 17C cause a pronounced stratification of water. The high temperatures were observed during the prevalence of fogs allowing heating of water during clear periods and a reduced cooling at night. (Wilde-Wisconsin) W71-08679

#### ECONOMIC FACTORS IN THE DEVELOP-MENT OF A COASTAL ZONE,

Massachusetts Inst. of Tech., Cambridge. For primary bibliographic entry see Field 06B.

# ESTUARIES -- AMERICA'S MOST VULNERA-

BLE FRONTIERS, National Wildlife Federation, Washington, D.C. For primary bibliographic entry see Field 05G. W71-08755

# THE COASTAL RESOURCES MANAGEMENT PROGRAM OF TEXAS: A SUMMARY

For primary bibliographic entry see Field 06E. W71-08759

#### SEAWATER INTRUSION IN STRATIFIED ESTUARIES,

Norwegian Inst. for Water Research, Oslo (Norway). Y. F. Oeztuerk.

Water Research, Vol 4, No 7, p 477-484, July 1970. 5 fig, 1 ref.

Descriptors: \*Estuaries, \*Flow measurements, \*Mathematical models, \*Saline water intrusion, Mathematics, Sea water, Water quality control, Reynolds number, Mixing, Saline water-freshwater interface, Velocity.

Identifiers: Seawater intrusion length measure-

The intrusion of seawater into estuaries is caused by density differences between seaward flowing river-water and seawater. An understanding of estuary flow conditions is essential to solving estuarine problems. Mathematical models for determining seawater intrusion length are presented. Formulas for representing estuary parameters and length correction factor are derived with field data demonstrations. In real estuaries the estuary shape factor is essential in determining the seawater intrusion length. Another important factor is the Reynolds number for the river, which introduces the factor of transition from one type of flow to another for certain riverflow velocities. Observations are made showing the importance of these two factors in the general formulaization of seawater intrusion length. (McEntyre-W71-08760

PHYSICAL DATA POTOMAC RIVER TIDAL SYSTEM INCLUDING MATHEMATICAL MODEL SEGMENTATION, MODEL SEGMENTATION,
Federal Water Quality Administration, Annapolis,
Md. Chesapeake Support Lab.
Norbert A. Jaworski, and Leo J. Clark.
Technical Report No. 43, 50 p, 8 fig, 15 tab.

Descriptors: \*Estuaries, \*Water quality, \*Physical properties, Measurement, Bridges, Buoys, Rivers, Water pollution control.
Identifiers: \*Potomac River Estuary, Data interpretation aids.

The physical characteristics of the Potomac Estuary are systematically and accurately defined. Factors considered for these water quality studies included surface and cross sectional areas, volumes, and distances between bridges, buoys, landmarks and other reference points. These factors are necessary for interpretation of field survey information and mathematical model studies. (Ensign-

PAI) W71-08774

#### NUTRIENT MANAGEMENT -POTOMAC ESTUARY, Federal Water Quality Administration, Annapolis,

Md. Chesapeake Support Lab. For primary bibliographic entry see Field 05C. W71-08775

EXPERIENCES WITH OPERATING AN AUTO-MATIC WATER QUALITY MONITORING SYSTEM IN AN ESTUARINE ENVIRONMENT, Federal Water Quality Administration, Edison, N.J. Hudson-Delaware Basins Office. For primary bibliographic entry see Field 05A. W71-08875

UTILITY OF RADIOISOTOPE METHODOLOGY IN ESTUARY POLLUTION CONTROL STUDIES-PART 1: EVALUATION OF THE USE OF RADIOISOTOPES AND FLUORESCENT DYES FOR DETERMINING LONGITUDINAL DISPERSION COEFFICIENT IN ESTUARIES, Quirk, Lawler and Matusky Engineers, New York. Quirk, Lawler and Matusky Engineers, New York. For primary bibliographic entry see Field 05G. W71-08928

## 03. WATER SUPPLY AUGMENTATION AND CONSERVATION

## 3B. Water Yield Improvement

WATER RESOURCES IN THE UPPER STONES RIVER BASIN, CENTRAL TENNESSEE, Geological Survey, Nashville, Tenn. For primary bibliographic entry see Field 02F. W71-08330

FIELD STUDIES OF THE INFILTRATION CAPACITY OF SOILS (RUSSIAN: O POLEVYKH ISSLEDOVANIYAKH VPITYVAYUSHCHEY SPOSOBNOSTI POCHVOGRUNTOV),

For primary bibliographic entry see Field 04A. W71-08384

# THE CALIFORNIA WATER PLAN, Loughborough Univ. of Technology (England). For primary bibliographic entry see Field 06B. W71-08446

REDUCTION OF STREAMFLOW INCREASES FOLLOWING REGROWTH OF CLEARCUT HARDWOOD FORESTS, Southeastern Forest Experiment Station, Asheville,

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Wayne T. Swank, and Junior D. Helvey. Symposium on the Results of Research on Representative and Experimental Basins, Welling-ton, (N.Z.), Pub No 96 AIHS, p 346-360, 1970. 7 fig, 3 tab, 14 ref.

Descriptors: \*Water yield improvement, \*Vegetation effects, \*Small watersheds, \*Vegetation regrowth, \*Clear-cutting, Deciduous forests, Evapotranspiration, North Carolina, Consumptive use, Water supply. Identifiers: Experimental watersheds, Coweeta Hydrolic Laboratory.

The mature hardwood forest on a 16-hectare catchment at the Coweeta Hydrologic Laboratory in North Carolina was initially clearcut in 1939. The first year following cutting, streamflow increased 360 mm. As the even-aged coppice stand regrew, annual streamflow increases approached pretreatment levels as a linear function of the logarith of time: after 23 years, streamflow was still slightly above pretreatment levels. The watershed was clearcut again in 1962, and streamflow response for the year following cutting was 380 mm. In striking contrast to the first cutting, streamflow increases have diminished at a much faster rate and it appears that annual water yield will return to pretreatment levels after just 16 years of forest regrowth following the second cutting. The difference in the measured watershed response is attributed primarily to a more rapid recovery of vegetation in the second treatment period. The results of another recent experiment on a watershed at Coweeta demonstrated that annual water increases obtained from clearcutting in the Southern Appalachian forests can be more shortlived than previous experiments have indicated.
W71-08838

#### AREAL SNOW COVER AND DISPOSITION OF RUNOFF SNOWMELT IN CENTRAL COLORADO,

Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

USDA Forest Serv Res Pap RM-66. 19 p, illus.

Descriptors: \*Aerial photography, \*Runoff, \*Snowmelt, Hydrologic data, \*Snowpacks, Snow surveys, \*Runoff forecasting, \*Streamflow forecasting, Hydrology, Small watersheds, \*Water balance, \*Rocky Mountain Region, Colorado, Weather modification.

Identifiers: \*Rocky Mountains, Fraser Experimental Forest, Colorado, Water Resources Program.

Areal snow-cover depletion and resultant snowmelt and water yield were studied on three small watersheds in the Fraser Experimental Forest. Higher water yield efficiencies were observed on two watersheds which had: (1) almost complete snow cover when seasonal snowmelt rates on all major aspects were maximum; (2) a delayed and short snow-cover depletion season; and (3) moderate recharge and evapotranspiration losses. Water yield efficiency in one watershed with lowelevation south slopes was least. In 1969, streamflow from the drainage area on this basin below 9,850 feet was less than 30 percent of that generated from above this elevation. Fourteen years of comparative streamflow indicated that water yields from the low elevation subdrainage can vary from near zero in poor runoff years to a maximum during good years of about 50 percent of the flow generated from the high elevation subdrainage. W71-08844

# PROJECT SKYWATER, PROCEEDINGS, SKY WATER CONFERENCE II. DESIGN AND EVALUATION OF WEATHER MODIFICATION EXPERIMENTS.

Bureau of Reclamation, Denver, Colo. Office of Atmospheric Water Resources.

Available from the National Technical Information Service as PB-196 197, \$6.00 in paper copy, \$0.95

in microfiche. Bureau of Reclamation report REC-OCE-70-58, Oct 67, 357 p.

Descriptors: \*Clouds, \*Weather modification, \*Cloud seeding, \*Cloud physics, Nucleation, Silver iodide, Ice, \*Artificial precipitation.
Identifiers: Cumulus clouds, Design convection, Computerized simulation, Skywater project.

The Bureau of Reclamation's Atmospheric Water The Bureau of Reclamation's Atmospheric Water Resources Program, Project Skywater, is developing the capability to apply precipitation management techniques to the solution of our nation's water needs. Evolutionary processes leading toward the best precipitation management system require the identification and analysis of the many problems in weather modification. The design and evaluation of weather modification experiments were presented at Skywater Conference II, and the importance of conducting field experiments in such a way that definitive answers to the posed questions can be given was stressed. Statisticians and experimental design people emphasized the need for allowing adequate time to obtain results. Their advice contained a caution that being in too great a hurry usually resulted in experimental failure, and that the more uncertainties involved in a particular experiment, the more the need for randomization. Experiments conducted in rugged terrain and under extreme weather conditions pose special problems. These problems added to the problems of adequate measurement of many parameters and new capabilities for measuring other parameters make the design of meaningful experiments extremely difficult.

# PROJECT SKYWATER, PROCEEDINGS, SKY-WATER CONFERENCE I PHYSICS AND CHEMISTRY OF NUCLEATION.

Bureau of Reclamation, Denver, Colo. Office of Atmospheric Water Resources.

Available from the National Technical Information Service as PB-196 196, \$3.00 in paper copy, \$0.95 in microfiche. Bureau of Reclamation report REG-OCE-70-57, July 1967. 419 p.

Descriptors: \*Weather modification, \*Cloud seeding, \*Nucleation, \*Cloud physics, \*Artificial precipitation, Silver iodide, Meteoric water,

Chemistry of precipitation. Chemistry of precipitation. Identifiers: \*Cloud modification, Orographic precipitation, USBR Research Contracts, Skywater Project, Pyrotechnic.

The Bureau of Reclamation's Atmospheric Water Resources Program, Project Skywater, is developing the capability to apply precipitation manage-ment techniques to the solution of our nation's water needs. Evolutionary processes leading toward the best precipitation management system require the identification and analysis of the many problems in weather modification. Skywater Conference I reviews the physics and chemistry of nucleation and the state of knowledge of these processes, and points out the importance of continuing research in this area. A consensus indicated that effective nucleants now exist, but there is doubt that any material now in existence is ready to be made the basis of a large-scale operational precipitation management program. Nucleants must be tailored to cloud requirements, and a variety of nucleants used in sequence might be the eventual operational system. The need for alternatives to the use of large amounts of silver in an operational precipitation management program was stressed. (USBR)
W71-08871

# EVALUATING WATERSHED MANAGEMENT ALTERNATIVES, Rocky Mountain Forest and Range Experiment

Station, Fort Collins, Colo. For primary bibliographic entry see Field 04D.

W71-08915

## 3C. Use of Water of Impaired **Ouality**

# CONTENT OF ADENOSINE PHOSPHATE COMPOUNDS IN PEA ROOTS GROWN IN SALINE MEDIA, Hebrew Univ., Jerusalem, (Israel). Dept. of

Edna Hasson-Porath, and Alexandra Poljakoff-Mayber.

Supported by a grant from the USDA (PL 480, A10-SWC-7; F9-IS-179). Plant Physiology, Vol 47, No 1, p 109-113, Jan 1971. 1 fig, 4 tab, 20 ref.

Descriptors: \*Saline water, \*Soil-water-plant rela-\*Phosphates, \*Plant physiology, \*Biochemistry, Sodium chloride, Sodium sulfate, Phosphorus compounds, Enzymes, Metabolism,

Identifiers: \*Adenosine triphosphate, \*Adenosine diphosphate, \*Phosphorylation, \*Phosphatases, \*Nicotinic adenine dinucleotide, Mitochondria.

It is known that various metabolic pathways of pea plant (Pisum sativum) roots are altered when ex-posed to saline media. Attempts were made to determine whether changes are induced in adenosine phosphate levels in response to saline media. Both sodium chloride and sodium sulfate caused decreases of 60-70% in the ATP/ADP ratio in the root tissue when salinity was varied from 0-5 atm. Phosphatase and ATPase activity in soluble and mitochondrial fractions of sodium chloridesalinized plants were considerably higher than control levels, but were unaffected in sodium sulfate-salinized root mitochondria. Probably, then, oxidasammed for intectionals. Frozony, then, oxida-tive phosphorylation is also directly affected by saline media. Salinity-induced mitochondrial phosphorylation depression was partially, but not completely reversed by the presence of NAD. Ad-dition of sodium chloride to the reaction mixture did not affect phosphatase activity, but in some cases, sodium sulfate addition depressed it. (Casey-Arizona) W71-08447

# BRAK, A THREAT TO OUR IRRIGATION SCHEMES,

Natal Univ., Pietermaritzburg (South Africa). Dept. of Soil Science. M. Hensley.

South African Journal of Science, Vol 66, No 6, p 180-181, June 1970. 6 ref.

Descriptors: \*Saline soils, \*Alkaline soils, \*Irrigation effects, \*Leaching, Evapotranspiration, Calcium. Sodium.

Identifiers: \*Leaching fraction, \*Waterlogging,

Brak soils are alkaline, saline or saline/alkali soils. Brak is a chronic problem in irrigated lands. Usually the soil solution becomes 2-10 times more saline than the water by which it is irrigated. Salt concentration results from evapotranspirational water loss, and to prevent concentration, it is water loss, and to prevent concentration, it is necessary to apply more irrigation water than that required to satisfy evapotranspirational demand. Once irrigation begins, soil salinity and exchangea-ble sodium should be carefully watched. Reclamation is through draining, leaching and replacement of exchangeable sodium by calcium. In South Africa, a brak survey of existing irrigation schemes and research on soil water movement are needed. It is necessary to be able to predict long term irriga-tion effects on each soil type and to integrate this into the planning of future irrigation schemes. (Casey-Arizona) W71-08464

# VEGETATION CHANGE FROM A SAND DUNE COMMUNITY TO A SALT MARSH AS RE-LATED TO SOIL CHARACTERS IN MARIUT DISTRICT, EGYPT, Alexandria Univ. (Egypt). Dept. of Botany.

For primary bibliographic entry see Field 021. W71-08475

# Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

# Group 3C-Use of Water of Impaired Quality

FURTHER STUDIES OF EUROTIA LANATA GERMINATION IN RESPONSE TO SALINITY, Utah State Univ., Logan. Dept. of Range Science; and Utah State Univ., Logan. Ecology Center. Lesley D. Clark, and Neil E. West. Southwestern Naturalist, Vol 15, No 3, p 371-375, Ech 20, 1071, 2 tah, 7 ref.

Feb 20, 1971. 2 tab, 7 ref.

\*Saline soils, \*Germination, Descriptors: \*Saine soils, \*Gerinmaton, \*Halophytes, \*Ecotypes, Seeds, Chlorides, Salts, Salt tolerance, Sulfates, Calcium, Potassium, Sodium, Sodium chloride, Utah. Identifiers: \*Seedlings.

An effort was made to determine whether winterfat (E. lanata) shows ecotypic variations within 1 valley. Seeds were collected at 3 sites in Curlew Valley, Utah: a pure bottom stand, a mixed bottom stand and mixed bench stand. The study employed a random block design with 4 replications at 4 levels of NaCl, Na carbonate, Ca chloride and K sulfate (0.0, 0.5, 1.0 and 2.0% solutions in 1.5% agar). All germination percentages decreased as salt level increased but differed significantly between salt levels and between seed sources for 3 of the salts. Chloride salts caused greater germina-tion depression than sulfate salts. Annual germina-tion differences are probably related to differences in seed source, production time and climatic dif-ferences. Nevertheless, the data suggests ecotypic differences between seeds from sites less than I mile apart. (Casey-Arizona) W71-08481

POSSIBLE IMPROVEMENT OF ACID SULPHATE SOILS IN COASTAL AREAS OF ASIA BY MEANS OF SEA WATER LEACHING. Economic Commission for Asia and the Far East, New York.

Resources Journal, United Nations Economic Commission for Asia and the Far East (ST/ECAFE/SER. C/87), p 81-82, Dec 1970. 2 p, 1

Descriptors: \*Leaching, \*Acidic soils, \*Sea water, \*Sulfates, \*Land reclamation, Irrigation practices, Drainage, Reclamation, Soil chemistry, Water chemistry.

Identifiers: \*Indonesia, \*Indochinese Peninsula, \*Acid-sulfate soils.

Acid sulphate soils are very widely distributed in the ECAFE region. Extensive areas are found along the coasts of Kalimantan in Indonesia. Some one million hectares are reported from the Mekong delta. Tests with an acid-sulphate soil sample from the San Francisco Bay area used the high-salt water dilution method for leaching and reclamation of sodic soils. Short columns of the soil were leached with various amounts of synthetic sea water and/or a five-fold dilution of sea water, followed by distilled water in each case, to determine changes effected in the pH and exchangeable-cation composition of the soil. The treatments applied and the results obtained are summarized. Leaching with sea water removes large amounts of Al, increases soil pH appreciably, and increases base saturation to some extent. The increases in base saturation result from increases in exchangeable Na and K, with the content of exchangeable Ca..Mg actually decreasing slightly. (Knapp-USGS) W71-08545

#### WARM WATER UTILIZATION,

Oregon State Univ., Corvallis. Dept. of Soils. L. Boersma.

Oregon State University, 1970. 49 p, 9 fig, 13 tab, 14 ref. OWRR Project B-009-ORE (1).

Descriptors: \*Water reuse, \*Heated water, \*Energy, Thermal water, Heat transfer, Agriculture, Power plants, Industries, Waste treatment, Aquatic animals, Heat budget, Soils, Social value, Cost analysis, Monetary benefits, Energy conversion. Identifiers: \*Waste heat.

Utilization of thermal water resulting from power generating plants as a supply of energy is proposed. The potential uses include heating homes, greenhouses, animal enclosures, soils, fermented organic wastes, and cultures of water inhabiting organisms. To avoid a loss of the valuable resource, the water may be recycled in a closed system, routed through either a soil warming loop, or evaporative cooling coils. Detailed information is included on the relation of heat and soil temperature, extensive and intensive cooling systems, production of farm crops, fish and algal cultures, and cost analysis. (Wilde-Wisconsin) W71-08671

REVIVING THE GREAT LAKES,

Chicago Univ., Ill. Center for Urban Studies. For primary bibliographic entry see Field 05G.

# 3D. Conservation in Domestic and **Municipal Use**

CHARACTERISTICS OF HOUSEHOLD WATER CONSUMPTION IN THREE NEW HAMPSHIRE COMMUNITIES,

New Hampshire Univ., Durham. Water Resources Research Center.

For primary bibliographic entry see Field 06D.

METROPOLITAN WATER MANAGEMENT: CASE STUDIES AND NATIONAL POLICY IM-

Urban Systems Research and Engineering, Inc., Cambridge, Mass

For primary bibliographic entry see Field 06B. W71-08516

### 3E. Conservation in Industry

A CASE HISTORY IN FOOD PLANT WASTE WATER CONSERVATION AND PRETREAT-

MENT EXPERIENCE, Artichoke Industries, Inc., Castroville, Calif. For primary bibliographic entry see Field 05D.

#### 3F. Conservation in Agriculture

WATER RESOURCES OF EAST BIHAR RIVERS.

Bihar State Irrigation Commission, Patna (India). For primary bibliographic entry see Field 02E. W71-08342

A DEVICE FOR MEASURING RUNOFF FROM CROP ROTATION FIELDS (RUSSIAN: USTROYSTVO DLYA IZMERENIYA STOKA VODY NA POLYAKH SEVOOBOROTA), For primary bibliographic entry see Field 04A. W71-08387

A STUDY OF THE EFFECTS OF INSTITU-TIONS ON THE DISTRIBUTION AND USE OF WATER FOR IRRIGATION IN THE LOWER

RIO GRANDE BASIN, Texas A and M Univ., College Station. For primary bibliographic entry see Field 06B. W71-08395

FIRST NATIONAL SYMPOSIUM ON FOOD PROCESSING WASTES PROCEEDINGS. For primary bibliographic entry see Field 05D.

ANIMAL FEEDS FROM VEGETABLE WASTES, Agricultural Research Service, Albany, Calif.
Western Utilization Research and Development

For primary bibliographic entry see Field 05D. W71-08421

ANCIENT TECHNOLOGY AND MODERN SCIENCE APPLIED TO DESERT AGRICUL-

Hebrew Univ., Jerusalem (Israel). Dept. of Botany. L. Shanan, M. Evenari, and N. H. Tadmor. Supported by the Rockefeller Foundation and the Edmond and James de Rothschild Memorial Fund. Endeavor, Vol 28, No 104, p 68-72, May 1969. 7 fig, 1 tab, 3 ref.

Descriptors: \*Runoff, \*Water control, \*Arid lands, Descriptors: "Runoft, "Water control, "Aria lands, 'Irrigation efficiency, \*Flood irrigation, Irrigation engineering, Drainage basins, Terracing, History, Loess, Soil types, Watershed management, Deserts, Crop response, Alfalfa, Grains, Drought resistance, Foreign lands, Photogrammetry, Water distribution (Applied), Watersheds (Basins). Identifiers: \*Negev Desert, \*Runoff agriculture, \*Microscriptomatre.

\*Microcatchments.

From 1957-1962 about 10,000 ha. were intensively surveyed in the Negev Desert of Israel in order to elucidate the irrigation farming techniques of suc-cessful ancient agricultural civilizations. Two prin-cipal methods of 'runoff agriculture' recognized were: farm units based on small watersheds and valley units based on large watersheds. Intricate water distribution systems, utilizing highly sophisticated distribution systems, entiring highly solutions irrigation engineering techniques, ensured full flood control. In order to test the validity of these conclusions, 2 typical ancient farms were reconstructed and farmed almost exactly as the ancients structed and farmed almost exactly as the ancients had. Over the past decade, these experimental farms have yielded a number of valuable results:

(1) In even the most extreme drought years, at least 1 flood supplied enough irrigation water to sustain the agriculture;

(2) the efficiency of microcatchments (up to 0.1 ha. in area) in average annual water harvest were 20-30 times greater than large wadis; (3) slopes of 2-3% gave the highest water yields, which could be increased by clearing them of stones; (4) a large variety of crops could be grown, and proved more drought-resistant than formerly thought, indicating that irrigated crops in general are overwatered. (Casey-Arizona) W71-08444

CONTENT OF ADENOSINE PHOSPHATE COMPOUNDS IN PEA ROOTS GROWN IN SALINE MEDIA, Hebrew Univ., Jerusalem, (Israel). Dept. of

For primary bibliographic entry see Field 03C. W71-08447

LAND UTILIZATION IN NONIRRIGATED AREAS.

Food and Agriculture Organization of the United Nations, Rome (Italy). Crop and Grassland Production Service. Roald A. Peterson.

Presented at an international conference, 'Arid Lands in a Changing World', Tucson, Arizona, June 1969. In: Arid Lands in Transition, Dregne, H E (ed), Pub No 90, AAAS, p 435-449, 1970. 4 ref.

Descriptors: \*Arid lands, \*Semiarid climates, \*Land management, \*Grazing, \*Dry farming, Land use, Water resources, Social aspects, Legal aspects, Economic feasibility, Ecosystems, Incremental income, Multiple purpose, Environmental effects, Productivity.
Identifiers: \*Population pressures.

The major form of land utilization in most arid regions is animal production through grazing. Population increases in most arid lands imply that both social and resource utilization factors must be revised. Arid zones present several unique factors

that render their development difficult: (1) Intensity of use is low in comparison with more favored re-gions, and misguided attempts at overintensifica-tion more quickly lead to environmental degradation; (2) Capital inputs yield relatively low increments in production, thereby discouraging inflow of new capital; (3) Intensification must be horizontal rather than vertical, owing to limited absorptive capacity; (4) Land uses have been poorly integrated and multiple usage has been limited; (5) Most countries with arid zones have been reluctant to invest in research and development, preferring more intensive exploitation of their humid regions. A number of detailed suggestions are advanced, involving institutional mechanisms, resource evaluation, education, research, institutional reorganization, capital incentives and water development. (Casey-Arizona) W71-08453

# AGRICULTURAL DEVELOPMENT IN INDIA, Indian Council of Agricultural Research, New

Delhi (India).

J. S. Kanwar.

Presented at an international conference 'Arid Lands in a Changing World', Tucson, Arizona, June 1969. In: Arid Lands in Transition, Dregne, H E (ed), Pub No 90, AAAS, p 451-470, 1970. 6 fig,

Descriptors: \*Arid lands, \*Water resources development, \*Research and development, \*Land use, Productivity, Crop response, Corn (Field), Wheat, Livestock, Groundwater, Soil types, Soil structure, Desalination, Wells, Irrigation practices, Water yield improvement, Education, Pest control. Identifiers: \*India, \*Developing countries, \*Green revolution, \*Central Arid Zone Research Institute, \*Coordinated research.

In underdeveloped countries such as India, the majority of the population is employed in relatively inefficient agriculture. The need to raise per capita productivity is great, and agricultural intensifica-tion must be vertical, since there are few remaining unexploited lands. The organization and goals of the Indian Council of Agricultural Research and the Central Arid Zone Research Institute are described. Indian research experience indicates that coordinated research projects, concentrating on a single problem category, are extremely successful. Crop improvement projects funded by American foundations and universities have been so successful that they have led to the 'green revolution'. In the arid zone, crop varieties have been developed that mature during the short rainy season. Groundwater surveys, tube well construc tion and desalination research combined with soil studies and new irrigation methods are increasing crop agriculture in the arid zone. However, great emphasis is also being placed upon water use efficiency which is leading to increased crop intensification. Agricultural education methods are also intensifying. The Indian approach to agricultural technology transformation is a massive effort. (Casey-Arizona) W71-08454

#### MEXICAN EXPERIENCE.

Escuela Nacional de Agricultura, Chapingo (Mexico). Dept. of Botany

Efraim Hernandez Xolocotzi.

Presented at an international conference, 'Arid Lands in a Changing World'. In: Arid Lands in Transition, Dregne, H E (ed), Pub No 90, AAAS, p 317-343, 1970. 7 fig, 8 tab, 25 ref.

Descriptors: \*Irrigation, \*Dry farming, \*Arid lands, \*Mexico, \*Livestock, Vegetation, Crops, Land use, Land tenure, Legal aspects, Social aspects, Xerophytes, Shrubs, Research and development, Research facilities, Goats, Fiber crops, Social impact, Watersheds (Divides), Foreign lands, Irrigation practices, Salinity, Semiarid climates, Ecology, Ecosystems, Wind erosion

Identifiers: \*Overgrazing, \*Population pressures.

Mexico has a prolonged empirical precolonial backlog of utilization of extremely limited arid lands resources. The introduction of metal tools, lands resources. The introduction of metal tools, cultivation and domestic livestock by the Spaniards widened exploitation of the arid zone. Initial ecological studies indicate that even in areas of small human populations, native wildlife and native vegetation have been drastically reduced, less productive wood plants have greatly extended their ranges, and wind erosion is widespread. However, intensive developments and improvements have also occurred. The arid zone states of the northeast and northwest have experienced massive irrigation and northwest have experienced massive irrigation development problems and with this have come widespread usage of fertilizers, mechanized equipment, crop diversification, extension services and agricultural research facilities. Other, less favored areas, have not been as extensively developed but are recipients of the advantages of a national commitment to agricultural research. Many projects are described: improvement of livestock forage, irrigation salinity, improved crop stocks, native plant utilization, goats, fertilizer experiments and crop gene banks. (Casey-Arizona) W71-08455

#### NORTH AFRICA: PAST, PRESENT, FUTURE,

Food and Agriculture Organization of the United Nations, Rome (Italy). Plant Production and Protection Division.

H. N. Le Houerou.

H. N. Le Houerou. First part of a paper presented at an international conference, 'Arid Lands in a Changing World', Tucson, Arizona, June 1969. In: Arid Lands in Transition, Dregne, H E (ed), Pub No 90, AAAS, p 227-278, 1970. 36 fig, 11 tab, 65 ref.

Descriptors: \*Social aspects, \*Arid lands, \*Regional analysis, \*Ecology, \*Water resources, Vegetation effects, History, Human population, Human pathology, Grazing, Farming, Land resources, Productivity, Soil conservation, Water conservation, Salinity, Irrigation practices, Livestock, Social impact. Identifiers: \*North Africa, \*Population pressures, \*Desertification, \*Potential evapotranspiration,

\*Land degradation.

The 4 countries of North Africa (Morocco, Algeria, Tunisia and Libya) share a common history and many similarities in both natural conditions and human populations. The various climates, soils, physiographies, vegetation and water resources of the area are described in detail and bioclimatological maps are presented. For over 12 centuries, the history of these regions has been characterized by endless warfare between nomadic and sedentary populations, which together with famines and epidemics, established an equilibrium between agricultural productivity and human population. The colonial conquests of the 19th and 20th centuries broke this equilibrium by establishing peace and introducing modern hygiene and medicine. The resulting population pressures have intensified forest degradation, water resource exploitation and soil erosion. Descrification, because of population pressures and bad agricultural practices, proceeds at the rate of 100,000 ha/yr. Some soil and water conservation methods are suggested. (Casey-Arizona) W71-08457

DESERTS OF ASIA, Leningrad State Univ. (USSR). Dept. of Geography. M. P. Petrov.

M. P. Petrov.

Presented at an international conference, 'Arid Lands in a Changing World', Tucson, Arizona, June 1969. In: Arid Lands in Transition, Dregne, H E (ed), Pub No 90, AAAS, p 279-302, 1970. 12 fig,

Descriptors: \*Agriculture, \*Deserts, \*Water resources, \*Mineral industry, \*Oil industry, Industrial production, Biomass, Productivity, Groundwater, Diversion, Irrigation programs, Social aspects, Grazing, Solar radiation, Rainfall, aspects, Grazing, Solar radiation, Rainfall, Desalination, Surface waters, Transportation, Greenhouses.

Identifiers: \*Thar Desert, \*Central Asia, \*Middle

Desert resources include 3 main aspects: biological productivity, water and mineral resources and solar and wind energy. Although biological turnover is rapid, biomass reserves are small, and the low biological productivity places severe limits on animal husbandry. When water resources are combined with solar radiation (irrigation), productivity may leap sharply. Much attention has been paid to subsurface water exploitation and it appears that such reserves are much higher in Asian deserts than formerly thought. In contrast to biological productivity, mineral resources of the deserts (oil, gas, metals, etc.) possess very high economic potential and stability. Through modern technological developments, and better transportation networks, the exploitation of Asian deserts is currently proceeding on a massive scale, particularly in the USSR. This is leading not only to agricultural and industrial changes but also to social changes. The development in the deserts of Soviet Central Asia of large water diversion and irrigation projects, resource exploration, grazing, mineral deposits, water resources, industry and transportation are described in detail. Developments in Chinese central Asia, the Middle East and the Thar Desert of India are also briefly discussed. Many aspects of modern technology such as pipeline construction, mining, desalination and desert hothouse agriculture are considered extremely promising, and arid land exploitation will probably continue to increase in the foreseeable future. (Casey-Arizona) W71-08458

#### GEOGRAPHIC CONSIDERATIONS IN PLANS FOR DEVELOPMENT,

Hebrew Univ., Jerusalem (Israel). Dept. of Geog-

raphy. David H. K. Amiran.

Presented at an international conference, 'Arid Lands in a Changing World', Tucson, Arizona, June 1969. In: Arid Lands in Transition, Dregne, H E (ed), Pub No 90, AAAS, p 89-103, 1970. 4 fig, 5

Descriptors: \*Arid lands, \*Geographical regions, \*Irrigation practices, \*Social aspects, \*Economic feasibility, Semiarid climates, Tourism, Speciality crops, Regional analysis, Desalination, Technical feasibility.

Identifiers: \*Developing nations, \*Technical assistance.

In arid zones, the realities of water scarcity and soil conditions rule out the practices of traditional agriculture or pastoralism by large populations. Large-scale irrigation projects are ruled out as major developmental factors in most arid regions. Irrigation is a form of advanced regional development which therefore requires an elaborate regional infrastructure of transportation, powerlines and social services. However, the typical discontinuous distributions of arid land settlement patterns to restricted areas of intensive occupance separated by wide unoccupied areas renders such infrastructural economics unrealistic. Additionally, high evaporative demand lowers the yield efficiency per unit of irrigation water, making initial investment costs extremely high. Desalinization will not be a panacea for arid lands either, even in coastal deserts. It is felt that 2 types of industry are most realistic for arid lands: (1) Tourism, (2) Off-season agriculture producing specialty crops for out-of-region markets, that command high unit prices. The major difficulties involving arid zone technical assistance are the requirements of risk capital which is usually more realistically commanded in other areas and the problem of transferability of technical assistance between populations at different levels of technological and managerial competence and between different climatic environments. (Casey-Arizona)

# Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

# Group 3F—Conservation in Agriculture

PRODUCTIVITY OF ARID AUSTRALIA,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Rangelands Research Unit.

Presented at an international conference 'Arid Lands in a Changing World', Tucson, Arizona, 1969. In: Arid Lands in Transition, Dregne, H E (ed), Pub No 90, AAAS, p 303-316, 1970. 5 fig, 2

Descriptors: \*Arid lands, \*Productivity, \*Land use, \*Water resources, \*Grazing, Sheep, Cattle, History, Land management, Land tenure, Vegetation effects, Economic feasibility, Transportation, Social aspects, Soil erosion, Soil types, Foreign lands, Political aspects, Environmental effects, Geographical regions, Mining. Identifiers: \*Australia.

Australia contains the largest desert land area of any country in the world. Nevertheless, 97% of her 12 million people live in the relatively fertile, highly industrialized coastal 'boomerang' of the southeast. Further the coastal 'boomerang' is largely independent of the arid zone, producing enough food and fiber for its needs, while still having reserve space and recoverage for treathy arounded production. In and resources for greatly expanded production. In a sense, then, the arid zone is a uniquely giant appendage to the coastal strip, and this has resulted the allocation of very few national resources for its development. The arid zone receives most of its rainfall in the summer, and as in all arid regions it is highly erratic. In other respects, it is singular. It is traversed by no high climate affecting mountain ranges or any permanent exogenous rivers. Soils are thin and infertile and there are no spiny or succulent plants. Indigenous perennials are of fairly low nutrient values, the best forage being annuals that occur only in rainy years. Most stock water supplies must be man-made and represent relatively high capital investments. Because of high transportation costs, only sheep and cattle may be economically raised. On the credit side, pests and diseases are minimal. Social problems are engendered by the vast land area, and medical, educational and cultural services are difficult to provide. The history, economics and land tenure system of the area are reviewed. Overexploitation and neglect are reducing the already low productivity of many areas, and the author feels that the nation is committing a serious error in its indifference to the problems of the arid region. (Casey-Arizona) W71-08460

PUBLIC ACTION: REQUISITE FOR SUCCESS, For primary bibliographic entry see Field 06B.

# LAND USE ECOLOGY AS A THEME IN

BIOGEOGRAPHY, Durham Univ. (England). Dept. of Geography. I. G. Simmons.

Canadian Geographer, Vol 14, No 4, p 309-322, Winter 1970. 2 tab, 37 ref.

Descriptors: \*Biogeography, \*Ecosystems, \*Land use, \*Productivity, \*Biological communities, Agriculture, Grazing, Forestry, Food chains, Food webs, Biomass, Watersheds, Xcrophytes, Trophic level, Energy conversion, Water conservation, Ecological distribution, Environmental effects, Mode of action.

In reviewing land use systems, ecosystems are looked at from the human standpoint. The dimension of human culture is important because many resource processes which are ecologically possible are culturally unacceptable. Ecosystems are considered as layered trophic levels, characterized at sidered as layered tropine levels, characterized at each level by taxonomic and numerical diversity. Biogeochemical cycling through levels may be represented by food chains or food webs, and sta-bility is related to organismic diversity, since the buffering capacity to change in the ecosystem in-creases with numbers of species. Human activities usually affect ecosystem simplification by decreasing species diversity and energy pathways. An extreme case is modern agricultural monoculture such as cornfields, where stability is maintained by high inputs of matter and energy. Man may also af-fect systems by altering their critical limits. Land set aside for recreation or conservation is usually the least affected, and only esthetic satisfaction is gained. In water catchment areas, although localized changes may occur from terrestrial to aquatic systems, the watershed itself is little affected. Grazing is the extensive pastoralism of a selected domesticate, with all other herbivores considered pests. Badly controlled grazing often creates tremendous changes in ecosystems, such as the inva-sion of semiarid grasslands by xerophytic shrubs. Two critical limiting factors are herbivore conver-sion efficiency and herbivore selectivity. Forest is a sort of grazing operation which often leads to soil erosion and river silting. Shifting agriculture is most practiced in the tropics and involves interference with the rapid mineral cycling by the native vegeta-tion, and quick depletion of soil minerals. Sedentary agriculture is mainly monocultural and decreases productivity but increases man's crop. (Casey-Arizona) W71-08462

# THE EFFECT OF WATER STRESS ON IN-DOLEACETIC ACID OXIDASE IN PEA PLANTS,

Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.

For primary bibliographic entry see Field 021. **W71-**08463

# BRAK, A THREAT TO OUR IRRIGATION SCHEMES,

Natal Univ., Pieter Dept. of Soil Science. Pietermaritzburg (South Africa).

For primary bibliographic entry see Field 03C. W71-08464

# NOTE ON HYDROLOGICAL RESEARCH IN BOTSWANA WITH SPECIAL EMPHASIS ON RESEARCH IN THE HYDROGEOLOGICAL FIELD.

Botswana Geological Survey, Lobatse. For primary bibliographic entry see Field 04B. W71-08467

# THE EFFECTS OF ANTITRANSPIRANT CHEMICALS ON THE TRANSPIRATION AND PHYSIOLOGY OF TAMARIX SPECIES,

Arizona Univ., Tucson. Dept. of Watershed Management. For primary bibliographic entry see Field 02D. W71-08469

LIVESTOCK PRODUCTION IN THE SUBTROPICAL AND TROPICAL AFRICAN COUN-TRIES.

Pretoria Univ. (South Africa). Dept. of Animal Science. Jan C. Bonsma.

South African Journal of Science, Vol 66, No 5, p 169-172, May 1970. 4 ref.

Descriptors: Livestock, \*Environmental effects, \*Rainfall, \*Tropical regions, \*Productivity, Savannas, Semiarid climates, Phosphorus, Iron, Nitrogen, Calcium, Hydrogen ion concentration, Humid areas, Nutrients, Ecology, Growth rates, Management, Subtropic, Grasses.
Identifiers: \*Hyperthermy, \*Performance testing,

\*Adaptability.

The tropical and subtropical regions contain about 2/3 of the world's livestock numbers, but produce only about 10% of the world's edible livestock products. More attention must be given to the interaction between environment and animals, and this is illustrated by the differences between semiarid regions (savannas) and humid regions. In

the low rainfall savannas, soil pH is usually near 7.0 the low rainfall savannas, soil pH is usually near 1.0 and Ca, P and N levels are adequate. Most grasses are high in protein and palatable during winter months. In the humid regions, soil nutrients are leached out by the high rainfall and the grasses are highly fibrous with high heat increment values. Hyperthermy therefore becomes a critical problem and well adapted animals must be utilized. Small animals with high surface area/volume ratios dissipate heat more quickly. In all areas, the 2 most important measures of adaptability are fertility and important measures of adaptability are fertility and weight gain. (Casey-Arizona) W71-08472

# NITROGEN IN AGRICULTURE: THE PROBLEMS AND THE EFFECT ON THE EN-VIRONMENT,

Edinburgh Univ. (Scotland). Stephen Watson.

Advancement of Science, Vol 27, No 131, p 25-37, Sept 1970. 5 fig, 5 tab, 15 ref.

Descriptors: \*Nitrogen, \*Water pollution effects, \*Land management, \*Environmental effects, \*Fertilizers, Ammonia, Nitrates, Ureas, Nitrogen fixation, Crop response, Nitrogen fixing bacteria, Nitrogen cycle, Legumes, Grasses, Proteins, Soil microorganisms, Sewage, Farm wastes.

About 80% of the world's human population utilizes only 20% of the world's available protein. The problem is not one of redistribution but of increasing protein supplies. World supplies of fixed N are divided into 60 million tons in animals, 1000 million in plants and 150,000 million in the soil. To this, 100 million tons are annually added by biological fixation and 10 million by industrial fixation. The production of N by soil microorganisms and the utilization of N by plants are reviewed in detail. The problem of proper pasture mixtures between grasses and legumes in combination with controlled grazing is considered and the phenomenon of increased N fertilizer application to grasslands is described. Combinations of legumes and grasses result in improved pastures and soil fertility but the process is too slow to rule out N fertilizer applications in combination with appropriate water applications. Field drying is a brittle process which may result in great protein loss unless carefully managed, particularly because of the high cost of evaporating water. The problem of water pollution due to increased N fertilizer application and intensified cattle feeding is considered in detail. Such pollution may be considerable, but will not be of the same order as that due to biological fixation, town sewage and industrial wastes. (Casey-Arizona) W71-08478

# SOME PHYSICAL ASPECTS OF WATER RESOURCE DEVELOPMENT IN TANZANIA, University Coll., Dar-es-Salaam (Tanzania). Dept. of Geography For primary bibliographic entry see Field 02D. W71-08483

#### SEMIAUTOMATIC IRRIGATION. Colorado State Univ., Fort Collins.

Colorado Farm and Home Research, Vol 19, No 4, July-Sept 1969, p 5, 1 fig.

Descriptors: \*Irrigation systems, \*Irrigation practices, \*Irrigation efficiency, \*Irrigation operation and maintenance, \*Water management (Applied), Instrumentation, Timing, Automatic control, Crop production, Hay, Turf, Labor, Costs, Check structures, Diversion, Water utilization, Plant growth regulators, Soil-water-plant relationships. Identifiers: \*Intermittent irrigation.

A semiautomatic irrigation system is described as consisting of a timer (cost \$8.50), wire and lumber. Intermittent irrigation improves hay yields and turf composition. The semiautomatic system was designed to reduce labor costs for intermittent ir-

rigation. The system reduces labor time from a day to 30 minutes. Drop-open or drop-close check gates are set in series to operate at predetermined intervals. Water may be diverted or permitted to flow to fields. The 24-hour time can be set to 13 gates for 2-hour irrigations. Water-use efficiency will increase under this system. A photograph shows an operator adjusting the timer. (Popkin-Arizona) W71-08484

THE EFFECT OF CROPPING SYSTEMS, FALLOW METHOD AND FERTILIZERS ON CROP YIELDS AND SOIL PROPERTIES OF SOUTHEASTERN COLORADO SOILS,

Colorado Agricultural Experiment Station, Fort

K. G. Brengle, H. O. Mann, and Robert S. Whitney. Colorado State University Experiment Station, Bulletin 536-S, January 1969. 22 p, 15 tab, 1 fig, 8 ref.

Descriptors: \*Fallowing, \*Fertilizers, \*Plant growth regulators, \*Crop production, \*Cultivation, Crop response, Soil properties, Rainfall, Evaporation, Limiting factors, Solar radiation, Wind velocity, Distribution, Humidity, Soil-water-plant relationships, Experimental farms, Lysimeters, Soil treatment, Data collections, Sorghum, Wheat, Wind erosion, Soil stability, Soil chemistry, Weed control, Colorado.

Identifiers: \*Cropping systems, Colorado Branch Experiment Station, Semi-arid lands.

Crop production is limited in Southeastern Colorado by an average annual rainfall of about 15 inches, average annual open-water-surface evaporation of about 78 inches, and variations in evaporation and rainfall distribution. High radiation and wind velocity, and low relative humidity favor evaporation. Conditions which affect soilwater-plant relationships were investigated at the Southeastern Colorado Branch Experiment Station from 1956 to 1966 using a split-plot and subdivided lysimeter. Treatments included fallowing, various lysimeter. Treatments included fallowing, various cropping systems and fertilization; soil, plant and water sampled and analyzed. Grain sorghum production was more stable than wheat. Wind erodibility, mechanical stability of soils, soil chemistry, and effects of continuous sorghum are discussed. The areal soils are highly crodible regardless of cropping, fallowing, tillage or fertiliza-tion regime. Mechanical and chemical weed con-trol was satsifactory. Tables show effects of various treatments on soil properties, crop yields, and income generated. Data on precipitation and evaporation are presented. (Popkin-Arizona) W71-08485

#### SPRINKLER IRRIGATION SYSTEM PLUS FER-TILIZER EQUALS FERTIGATION,

South Dakota State Univ., Brookings. Dept. of Agricultural Engineering; and Water Resources Inst., Brookings, S. D. John L. Wiersma.

South Dakota Farm and Home Research, Vol 20, No 1, Winter 1969, p 5-8. 7 fig.

Descriptors: \*Water conservation, \*Sprinkler irrigation, \*Irrigation systems, \*Water management (Applied), \*Fertilization, Irrigation efficiency, Nitrogen, Trace elements, Pressure head, South Dakota, Corrosion control, Safety factors, Pumps, Automatic control, Depth, Nutrients, Leaching.

Identifiers: \*Fertigation, Compressed air, Liquid fortilizes fertilizer.

Fertigation is the use of sprinkler irrigation systems as a method of applying fertilizers. Nitrogen and trace elements may be applied this way, with numerous types, methods and equipment. Pressure systems are limited by injection method and uniform-application demands. A constant low liquid volume is injected into the system according to a method developed by the Agricultural Experi-ment Station and Water Resources Institute at South Dakota University. Compressed air is injected into a liquid fertilizer tank, forcing the fertilizer through an orifice under constant head and minimum corrosion impact. A pivot maintains 75 pounds per square inch, and is controlled by a regular shop-type air compressor. Safety devices (check valves) operate if the compressor fails, and the pump continues, or the pump stops. The automated system was tested on a 140-acre lot, injecting 870 gallons of anhydrous ammonia in 70 hours. The safety features worked, and the method gave an accurate, economical fertilization. Advantages in-clude slight labor costs, use on tall crops, good sur-face distribution and depth placement, availability of solution nutrients, ease of leaching, and lower fertilizer requirement. Figures show schematic of air injection fertigator, control system and connections, safety features, and use. (Popkin-Arizona) W71-08486

# RETURNS FROM BEEF ON IRRIGATED PASTURES VS. RETURNS WITH OTHER

PASTURES VS. RETURNS WITH OTHER CROPS, Economic Research Service, Washington, D. C. Farm Production Economics Div; and Agricultural Research Service, Brookings, S. D. C. C. Micheel, J. T. Nichols, J. R. Johnson, F. W. Whetzel, and C. J. Erickson.
South Dakota Farm and Home Research, Vol 20, No 1, Winter 1969, p 12-13. 4 tab. Part of project SWC W21-dNL-6, ARS and SDSU.

Descriptors: \*Cattle, \*Benefits, \*Crop production, \*Return (Monetary), \*Comparative productivity, Water conservation, Water utilization, Irrigated land, Pasture management, Forages, Grasses, Alfal-fa, Bromegrass, Orchard grass, Hay, Corn (Field), South Dakota.

Identifiers: \*Beef production, Belle Fourche Irrigation Project (South Dakota).

Irrigated pastures provide important forages for beef. Expected returns for irrigated pastures are compared with returns of other crops for a 1965-67 study in the Belle Fourche Irrigation Project (South Dakota). Irrigated pastures consisted of a mixed alfalfa, brome and orchard grass. Other crops were corn and hay. Corn, hay and irrigated-pasture returns on 500-pound steers were comparable, though irrigated crops were not shown to be superi-or to other crops. Four tables show average beef production, costs and returns on irrigated pasture, irrigated crop, irrigated alfalfa-brome and break-even returns from beef on irrigated pasture. (Pop-W71-08488

#### RANGE SITE SOURCES FOR LIVESTOCK WATER.

Department of Agriculture, Newell, S. D. Irrigation and Dry Land Field Station. Armine R. Kuhlman.

Supported by US Department of Agriculture and South Dakota Agricultural Experiment Station. South Dakota Farm and Home Research, Vol 20, No 1, Winter 1969, p 13-17. 6 fig.

Descriptors: \*Livestock, \*Range management, \*Surface runoff, \*Ponding, \*Rainfall-runoff relationships, Consumptive use, Water supply, Economic efficiency, South Dakota, Sands, Loam, Forages, Watershed management, Experimental farms, Dikes, Flumes, Precipitation (Atmospheric), Seasonal, Variability, Snowmelt, Water storage, Seepage, Controlled drainage, Evapora-tion, Water loss, Clays, Water yield improvement,

Water conservation. Identifiers: \*Panspots, \*Solonetz soils, Containers.

Surface runoff, stored in ponds, is an economical water source on South Dakota livestock ranges. Range sites are of two types: panspots, on solonetz soils, where livestock find accumulated water; and sandy range sites, on normal coarse-to-fine sandy loams, where good forage production is possible. Two range site watersheds of 43 acres were investigated as experimental areas from 1962 to 1967. Confining dikes directed runoff to dischargemeasurement flumes. Over 16 times as much

livestock water came from panspots, where runoff occurred more frequently for the same precipitaoccurred more frequently for the same precipita-tion. Seasonal variations, snow melt, and vegetative aspects are discussed. Water storage problems may be solved with ponding on panspot sites to reduce seepage. Watershed configuration controls runoff transmission and water loss. Livestock water needs may be met with ponding on heavy clay soils and with partially sealed containers. Six figures show a measuring flume, snow accumulation, and graphs of potential water supply, snowmelt and rainfall of potential water supply, snowmelt and rainfall yield, and runoff variation. (Popkin-Arizona) W71-08489

#### RESEARCH RELATES NEBRASKA WATER USE, WEATHER

Nebraska Univ., Lincoln. Dept. of Horticulture and

For primary bibliographic entry see Field 02D. W71-08490

# ECOLOGICAL AND PHYSIOLOGICAL IMPLICATIONS OF GREENBELT IRRIGATION: FIRST ANNUAL REPORT OF THE MALONEY CANYON PROJECT, California Univ., Riverside. Dept. of Agronomy.

For primary bibliographic entry see Field 06G. W71-08491

# INCREASING SPRINKLING EFFECTIVENESS (RUSSIAN: SPOSOB POVYSHENIYA EFFEKTIVNOSTI DOZHDEVANIYA), Vsesoyuznyi Nauchno-Issledovatelskii Institut Sel-

skokhozyaistvennogo Mashinostroeniya, Moscow

B. M. Lebedev, I. K. Makarets, B. A. Voronyuk, O.

E. Frey and G. P. Lyampert.
Gidrotekhnika i Melioratsiya, No 1, p 48-52, Jan 1971. 5 p, 3 fig, 8 tab.

Descriptors: \*Sprinkler irrigation, \*Wetting, \*Crop production, \*Runoff, \*Soils, Water delivery, Chiselling, Fertility, Permeability, Irrigation water, Sprinkling, Equipment.
Identifiers: \*USSR, Chisels.

Runoff of rain water and uneven wetting of soil lead to irregular ripening of plants and to a decrease in crop yield. Runoff and low permeability of soils have an adverse effect on sprinkler effectiveness, since the position of a sprinkler must be changed when runoff begins. One of the means of reducing runoff, erosion and the uneven wetting of soil during sprinkler irrigation is to create small ridges on the soil surface at the time of sowing, fall-plowed fields, and to use chisels on hayfields and pastures. Small machine-made ridges on the surface of a field and chiselling will make it possible to utilize sprinklers more effectively, prevent runoff and erosion, provide more uniform soil wetting, and contribute to higher crop yield. (Josefson-USGS) inter-row cultivation, and water-supply irrigation of W71-08583

# IRRIGATION PRACTICES AND IRRIGATION EROSION OF SOILS, (RUSSIAN: TEKHNIKA POLIVA I IRRIGATSIONNAYA EROZIYA POCHV).

Kh. Kh. Khamadamov, and I. Berdikulov. Gidrotekhnika i Melioratsiya, No 1, p 59-61, Jan 1971. 3 p, 4 tab.

Descriptors: \*Irrigation practices, \*Furrow irrigarion, \*Irrigation water, \*Erosion control, \*Slopes, Rates of application, Topography, Nutrients, Fertility, Return flow, Soils, Particle size. Identifiers: \*USSR, Uzbek SSR, Samarkand Oblast,

Irrigation crosion, Nutrient losses.

Studies conducted in the Payaryksiy Rayon of the Samarkand Oblast for irrigation-erosion control reveal a clear correlation between relief and irrigation water: the steeper the slope of an irrigation plot the more severe the irrigation erosion. In areas

# Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

# Group 3F—Conservation in Agriculture

with flat slopes (0.001-0.005) irrigation erosion is negligible regardless of the amount of irrigation water applied to a furrow. The extent of erosion and transport of soil particles beyond the area is 8-10 times less than in areas with steep slopes (0.01-0.05). Irrigation erosion leads to loss of humus, nitrogen, and phosphorus from the soil and to reduced soil fertility. Application of excess irrigation water results in loss of soil clay fractions, thereby contributing to coarser particle-size composition of the soils. To prevent slopes from exceeding 0.002-0.01, contour furrowing is needed to control erosion in areas with steep slopes. (Josefson-USGS) W71-08585

ENVIRONMENTAL PROTECTION-TVA EX-

PERIENCE, Tennessee Valley Authority, Chattanooga. For primary bibliographic entry see Field 06G. W71-08640

# THE V I LENIN KARAKUM CANAL IN THE TURKMEN SSR, K. F. Efremov, O. S. Lavronenko, and M. M.

Hydrotechnical Constr, No 4, p 346-350, Apr 1970. 5 p, 1 fig.

Descriptors: \*Canal construction, Canals, Canal seepage, Climate, Arid climates, Economics, Arid lands, Industrial water, Foreign construction, Irrigation systems, \*Irrigation, Irrigable land, Investment, Reservoirs, Agriculture, \*Water supply, Regime, Reclamation, Land reclamation.

Identifiers: Karakum Canal, USSR, Industrial development, USSR.

The V I Lenin Karakum Canal, 840-km long, carries the waters of the Amu Dar'ya River to Ashkhabad, the capital of Turkmen SSR. The Karakum Canal transports water to the dry regions of the Republic, the Murgab and Tedzhen Oases, the Kopet-Dag area, and western and southwestern regions. In its present state of completion, the canal provides irrigation for 240,000 ha of new lands. Of all the Union Republics, the area served has the sparsest water resources. Water was insufficient for irrigation, and centers of population did not have adequate supplies. Otherwise, conditions were favorable for agricultural development. In the Karakum Canal area, collective farms have been or are being set up and reclamation of new lands is being accomplished. On lands presently irrigated, reconstruction of irrigation systems is planned. The Regional Plan of Turkmen SSR shows that the cost of the V I Lenin Karakum Canal, taking into account expenditures for land improvement, organizing collective farms, and the outlay by the government for developing industry adapted to production on land irrigated from the canal, was fully returned to the government by 1964, and a profit of 615 million rubles was produced by 1969. (USBR) W71-08645

#### ECONOMIC ANALYSIS OF IRRIGATION IN SUBHUMID CLIMATE,

Montana State Univ., Bozeman. Dept. of Agricultural Economics.

Oscar R. Burt, and M. S. Stauber.

American Journal of Agricultural Economics, Vol 53, No 1, p 33-46, Feb 1971. 5 tables, 2 figures, 21 references.

Descriptors: \*Irrigation programs, \*Decision-making, \*Economic efficiency, \*Model studies, Corn (Field), Evaluation, Irrigation, Irrigation efficien-

cy. Identifiers: \*Soil Conservation Service, Cobb-Douglas, Missouri.

An economic model is developed for analysis of investments in irrigation. The model encompasses the associated problem of temporal allocation of limited irrigation water within the growing season of a single crop. The problem is placed in the

framework of stochastic dynamic programming, and it is snown how the algebraic form of the production function for the crop determines the appropriate state variables of the decision process. An application of the model is made to conditions prevalent in central Missouri with corn the irrigated crop. (Holmes-Rutgers) W71-08824 and it is shown how the algebraic form of the

THE RUNOFF REGIME DURING SUBSURFACE DRAINAGE OF PEAT BOGS (RUSSIAN: REZHIM STOKA PRI OSUSHENII TOR-FYANIKOV ZAKRYTYM DRENAZHEM), Vsesoyuznyi Nauchno-Issledovatelskii Institut For primary bibliographic entry see Field 04A. W71-08934 Gidrotekhniki i Melioratsii, Moscow (USSR).

## 04. WATER QUANTITY MANAGEMENT AND CONTROL

## 4A. Control of Water on the Surface

PROBLEMS OF HYDROLOGIC FORECASTS AND COMPUTATIONS (RUSSIAN: VOPROSY GIDROLOGICHESKIKH PROGNOZOV RASCHETOV).

Kryzhanovskaya, A.B. (ed), Ukrainskiy Nauchno-Issledovatel'skiy Gidrometeorologicheskiy Institut Trudy, No 76, Moscow, 1969. 152 p.

Descriptors: \*Runoff forecasting, \*Discharge (Water), \*Rainfall-runoff relationships, spranger (Water), \*Watersheds (Basins), Snowmelt, River (Atmospheric), graphs, \*Watersheds (Basins), Snowmelt, River basins, Base flow, Precipitation (Atmospheric), Peak discharge, Moisture content, Climatic data, Water yield, Flow rates, Statistical methods, Time lag, Water balance, Hydrologic budget.

Identifiers: \*Ukrainian rivers, Carpathia, Snow reserves, Balance method, Channel storage, Travel time, Isochrones,

This issue of the serial publication, which contains 16 papers, discusses the results of formulating methods for forecasting some of the characteristics of spring runoff from rivers of the Dnieper and Dniester basins and of rain floods on rivers of Transcarpathia. Studies of snowmelt characteristics and the infiltration capacity of soils during summer at the Boguslav Experimental Station are examined. A number of articles are concerned with computations involving the transformation of water movement in river channels, determination of the ordinates of spring runoff hydrographs, computations of water resources and the water balance of individual river basins, and determination of minimum discharges for Ukrainian rivers. A device for computing runoff on agricultural fields is described. (See also W71-08375 thru W71-08390) (Josefson-USGS) W71-08374

LONG-RANGE FORECAST OF WATER IN-FLOW TO THE KIEV RESERVOIR DURING A SPRING HIGH-WATER PERIOD (RUSSIAN: DOLGOSROCHNYY PROGNOZ PRITOKA VODY ZA PERIOD VESENNEGO POLOVOD-'YA K KIYEVSKOMU HRANILISHCHU), VODOK-L. T. Pashova.

In: Voprosy gidrologicheskikh prognozov i raschetov, Ukrainskiy Nauchno-Issledovateľskiy Gidrometeorologicheskiy Institut Trudy, No 76; p 3-16, 1969. 4 fig, 6 tab, 19 ref.

Descriptors: \*River flow, \*River forecasting, \*Snowmelt, Runoff, Melt water, Permeability, River basins, Base flow, Precipitation (Atmospheric), Freezing, Moisture content, Soil moisture, Seasonal, Heat budget.

Identifiers: \*Ukraine, Sozh River, Dnieper River, Pripyat' River, Snow storage, Freezing depth.

A method is suggested for computing and forecasting water flow to he Kiev reservoir during a high-water period, taking into account characteristics of water period, taking into account characteristics of spring runoff formation on the Dnieper, Sozh and Pripyat' River basins. Basin water storage before start of spring snow thaw was determined from irregular snow accumulation in the forest and field and evaporation from the surface of basins during time of snow melt. An analysis of the formation of melt water losses in highly waterlogged, forested areas and expanses with a shallow water table showed that the soil moisture content of the basin is showed that the soil moisture content of the basin is of primary importance in determining amount of meltwater loss. Prespring wetting of the upper meter layer of soil was used to describe water permeability of the soils in the Dnieper and Pripyat' basins and water storage in a frozen soil layer to indicate water permeability of soils in the Sozh basin. Relationships were derived for melt water as a function of total maximum snow storage and prescipitation during snowmelt and water neurosa. precipitation during snowmelt and water permeability of the soils for the three areas studied. (See also W71-08374) (Josefson-USGS)

A METHOD FOR FORECASTING MAXIMUM DISCHARGES OF WATER FLOW INTO THE KIEV RESERVOIR (RUSSIAN: METOD PROGNOZA MAKSIMAL'NYKH RASKHODOV PRITOKA VODY V KIYEVSKOYE VODOKHRANILISHCHE),

A. B. Kryzhanovskoya.
In: Voprosy gidrologicheskikh prognozov i raschetov, Ukrainskiy Nauchno-Issledovatel' skiy Gidrometeorologicheskiy Institut Trudy, No 76; p 17-22, 1969. 2 fig, 1 tab, 6 ref.

Descriptors: \*Runoff forecasting, \*Discharge (Water), \*Flow, \*Reservoirs, \*Peak discharge, Snowmelt, Air circulation, Soil moisture, Seasonal, Air temperature, Snow cover, Thawing. Identifiers: \*Ukraine, Dnieper River, Sozh River, Pripyat' River.

A method is proposed for forecasting maximum discharge of water flow into the Kiev reservoir based on a discrete account of hydrometeorological characteristics of three partial basins. Although the relationships between maximum water discharges and total spring runoff or hydrometeorological factors are quite close, and additional variable describing the change in atmospheric circulation during the second half of the year is introduced to increase accuracy of forecasts. The variable used is the sign of the difference between the indices of atmospheric circulation during February and the half-sum of December and January. It is concluded that the ratio of peak flow to basin yield during high-water formation in the Dnieper River basin has a considerable effect on the height of high water, parsiderable effect on the height of high water, particularly during years of inadequate soil moisture and low rate of snowmelt. Special studies are required of hydrologists and weather forecasters for working out a method for predicting peak flow during formation of high water. (See also W71-08374) (Josefson-USGS) W71-08376

ACCOUNTING FOR PEAK FLOW DURING A HIGH-WATER PERIOD IN COMPUTATIONS
AND FORECASTS OF A SPRING RUNOFF
MAXIMUM (RUSSIAN: OB UCHETE DRUZHNOSTI RAZVITIYA POLOVODYA V RASCHETAKH I PROGNOZAHK VESENNEGO MAKSIMUMA), M. V. Rudometov.

In: Voprosy gidrologicheskikh prognozov i raschetov, Ukrainskiy Nauchno-Issledovatel' skiy Gidrometeorologicheskiy Institut Trudy, No 76; p 23-33, 1969. 3 fig, 3 tab, 9 ref.

Descriptors: \*Peak discharge, \*Discharge (Water), \*Runoff forecasting, \*Surface runoff, Air tempera-

ture, Moisture content, Seasonal, Frozen soils, Meteorological data, Watersheds (Basins). Identifiers: \*Ukraine, Desna River, Snow storage,

A method for computing and developing a longrange forecast of maximum discharge of high water range forecast of maximum discharge of high water for the Desna River near Chernigov is examined in connection with the depth of spring surface runoff and the ratio of peak flow to basin yield during high water. To prepare a forecast of maximum discharge, the depth of spring surface runoff is precomputed from an earlier proposed method; the value of the ratio of peak flow to basin yield is precomputed from a relationship which uses maximum snow storage in the hasin at the end of winter. imum snow storage in the basin at the end of winter multiplied by the relative moisture coefficient for a frozen soil layer, the sum of negative average 10-day air temperatures from the start of winter through January and the sign of the change in the barometric field over the basin from the first half of winter (December-January) to the second half (February). Studies show that introduction of a precomputed value of peak flow into a forecast of maximum discharge for the Desna River increases substantially its accuracy. (Josefson-USGS) W71-08377

FORMATION OF RAINFALL FLOODS ON THE FORMATION OF RAINFALL FLOODS ON THE LATORITSA RIVER AND A FORECAST OF THEIR MAXIMUM DISCHARGES (RUSSIAN: FORMIROVANIYE DOZHDEVYKH PAVOD-KOV NA R. LATORITSE I PROGNOZ IKH MAKSIMAL'NYKH RASKHODOV), G. V. Pavlenko.

In: Voprosy gidrologicheskikh prognozov i raschetov, Ukrainskiy Nauchno-Issledovatel' skiy Gidrometeorologicheskiy Institut Trudy, No76; p 34-42, 1969. 2 fig, 9 ref.

Descriptors: \*Runoff forecasting, \*Flood forecasting, \*Base flow, \*Moisture content, \*Discharge (Water), Floods, Precipitation (Atmospheric), Air temperature, Surface-groundwater relationships,

Identifiers: \*Ukraine.

Rainfall-runoff conditions are described for the Carpathian River Latoritsa near Mukachev. The basin area is 1,380 sq km. An empirical relationship is established between the runoff depth of individual floods and precipitation over a computed time interval and the moisture content of the soils. A combination of three values was used to describe soil moisture content: the river preflood discharge caused by groundwater, precipitation during lag of maximum base flow, and air temperature during a day of rainfall. Recommendations for determining groundwater values are based on the use of the relationship of surface and groundwater maxima and a typical base flow recession curve. A system for separating complex floods into individual floods by means of two typical recession curves--surface water and groundwater-- is proposed. A forecast of maximum discharges of floods is based on the relationship of the volumes of runoff of individual floods to their maximum discharges. The forecast method developed insures an accuracy satisfactory for preparing forecasts ten hours in advance. (See also W71-08374) (Josefson-USGS) W71-08378

RATES OF MELT WATER FLOW ALONG SLOPES (RUSSIAN: O SKOROSTYAKH STEKANIYA TALOY VODY PO SKLONAM), M. S. Delcur.

In: Voprosy gidrologicheskikh prognozov i raschetov, Ukrainskiy Nauchno-Issledovatel'skiy Gidrometeorologicheskiy Institut Trudy, No 76, p 56-70, 1969. 3 fig, 9 ref.

Descriptors: \*Flow rates, \*Melt water, \*Slopes, \*Water yield, Snowmelt, Ice, Ice-water interfaces, Snow cover, Discharge (Water).

Identifiers: \*Ukraine, Slope characteristics, Snow storage, Ice crust.

Experimental studies conducted in 1967 at the Boguslav Experimental Hydrologic Field Station in the Dovzhik basin have established a relationship between rates of melt-water flow under snow and the rate of water yield from snow, the surface slope, height of snow in the area of observations and slope roughness. The rate of melt-water flow along slopes varies between 0.23 and 7.5 mm/sec. Flow rates under snow for an ice crust in areas with 9-13 deg slopes average half those in areas with 21-22 deg slopes when water yield rate and height of snow are equal. Given an equal rate of water yield from snow, flow rates along an ice crust are 1.5-3.5 (and snow, now lates along an ite crust are 135-35 (and occasionally 5) times less when average height of snow is 25-35 cm than when snow heights are 15-20 cm. Flow rates for melt water vary between 0.2 and 7.5 mm/sec when a compact ice crust is present on the soil surface. Given an equal rate of water yield, flow rates for a loose ice crust range from 0.5 to 4.0 mm/sec, which is almost 2-2.5 times less than the rate for a compact crust. The flow rate under snow for ice crust-free soil varies between 2 and 6 mm/sec. Flow rates in an open river course during an initial period of thaw are 10-50 mm/sec and in succeeding periods 200-500 mm/sec. Maximum flow rate in a stream was observed to be 1.25 m/sec. Flow rate in open river courses was examined as a function of their water discharges. However, deviations in the values of flow rates from the line of the relationship averaged plus or minus 15%, which was explained by a failure to take into account the effect of surface slopes. (See also W71-08374) (Josefson-USGS). W71-08380

PRICIPLES FOR CONSTRUCTING HIGH-WATER HYDROGRAPHS (RUSSIAN: METODICHESKIYE OSNOVY POS-

METODICHESKITE OSHOVI TROYENIYA GIDROGRAFOV VYSOKIKH POLOVODIY), V.I. Moklyak, and P. A. Shkryabiy. In: Voprosy gidrologicheskikh prognozov i raschetov, Ukrainskiy Nauchno-Issledovatel' skiy Gidrometeorologicheskiy Institut Trudy, No 76, p 71-79, 1969. 2 fig, 3 tab, 5 ref.

Descriptors: \*Hydrographs, \*Statistical methods, \*Probability, \*Discharge (Water), \*Water balance, Inflow, Melt water, Runoff, Surface runoff, Channel flow, Hydrologic data, Equations, Peak discharge.
Identifiers: \*Ukraine, Sozh River, Distribution curves, Balance method.

A statistical genetic method for determining spring high-water discharges, including maximum discharge, equivalent to the total depth of runoff, is examined. Computations are performed by means of water balance equations based on daily layers of flow into a channel network of given excess probability, established from statistical processing of daily layers of flow for previous years. The results of computations make it possible to determine maximum discharges of very low excess probability (less than 1%) and thus refine the distribution curve of excess probabilities of maximum discharges, which in this zone is not usually based on observation data. The computed maximum discharges within the zone of very low excess probabilities are often below the discharges determined by the three-parameter gamma distribution curve, whose parameters have been computed from long-term annual maximum discharge values for melt water. To illustrate the computation method proposed, hydrograph discharges and maximum discharges of the Sozh River near Gomel' with an excess probability of 1.0, 0.1 and 0.01% are used. (See also W71-08374) (Josefson-USGS)

DETERMINING UNIT INFLOW OF MELT WATERS FROM A BASIN BY A UNIT HYDRO-GRAPH (RUSSIAN: OPREDELENIYE ELEMEN-TARNOGO PRITOKA TALYKH VOD S BAS-SEYNA PO YEDINICHNOMU GIDROGRAFUL), In: Voprosy gidrologicheskikh prognozov raschetov, Ukrainskiy Nauchno-Issledovateľskiy Gidrometeorologicheskiy Institut Trudy, No 76, p 80-85, 1969. 2 fig, 1 tab, 9 ref.

Descriptors: \*Unit hydrographs, \*Melt water, \*Inflow, \*Discharge (Water), Runoff, Time lag, River flow, Water yield, Recession curves.
Identifiers: \*Ukraine, Desna River, Channel storage, Lag coefficients.

A genetic method for computing the transforming effect of a channel capacity on inflow into a river network from a basin during formation of high waters is examined. Computation of unit inflow by means of retransformation of observed discharges of runoff hydrographs is based on construction of a hydrograph from refined genetic runoff formulas and on a theoretical method of determining a unit hydrograph by lag coefficients. Ordinates of a unit hydrograph by tag coefficients. Ordinates of a unit hydrograph are computed on the basis of a chart of basin unit widths and a chart of basin widths constructed from the maximum rate of lag of a flood wave. Used in the computations are ratios between maximum velocity of wave frontal movement and average velocity by river length and between the volumes of channel storage and their corresponding discharges. Lag coefficients are computed from formulas which take into account the most probable structure of river flow, determined by roughness and shape of the channel course and the river floodplain. Unit inflow of melt waters from the Desna River basin to Bryansk during a 1931 high-water period is used as an example of computation. Maximum daily unit inflow is determined two days before maximum discharge of high water two days before maximum discharge of high water and equals 31.8 mm/day, which amounts to 1.82 of the maximum runoff depth (17.5 mm/day) and 0.20 of the total runoff depth (162 mm) for 16 days of intensive inflow of melt waters from the basin into the river network. The unit hydrograph method is recommended for use in determining daily rate of inflow and for analyzing typical shapes for unit inflow charts. (See also W71-08374) (Josefson-USGS) W71-08382

STUDY OF THE RELATIONSHIP OF A RU-STUDY OF THE RELATIONSHIP OF A RUNOFF COEFFICIENT TO HYDROGRAPHIC
CHARACTERISTICS OF A RIVER AND LAG
TIME OF A FLOOD WAVE (RUSSIAN: ISSLEDOVANIYE ZAVISIMOSTI KOEFFITSIENTA OTTOKA OT GIDROGRAFICHESKIKH
KHARAKTERISTIK REKI I VREMENI
DOBEGANIYA PAVODOCHNOY VOLNY),
YA A FOMENKO

Posteciant Arayobochnot volkt), Ya. A. Fomenko. In: Voprosy gidrologicheskikh prognozoy i raschetov, Ukrainskiy Nauchno-Issledovateľskiy Gidrometeorologicheskiy Institut Trudy, No 76, p 86-91, 1969. 3 fig, 14 ref.

Descriptors: \*Runoff coefficient, \*Channel morphology, \*Floods, \*Time lag, Chezy equation, Mannings equation, Roughness (Hydraulic), Hydraulic properties, Flow, Watersheds (Basins). Identifiers: \*Ukraine, Dnieper River, Southern Bug River, Severskiy Donets River, Azov Sea.

Although the relationship of the runoff coefficient Although the relationship of the runoff coefficient to a basin area or river length has not been adequately expressed, it can, in individual homogeneous geomorphological regions, be more specific when taking into account a stream gradient. A stream gradient is dependent upon the geomorphological characteristics of a channel and, to a certain extent, determines the capacity of channel storage and lag time of a flood wave. By taking into account the extent of forested areas and the waterlogged state of a basin, a clearer relationship can be derived between coefficients of runoff and causative factors. The runoff coefficients, as a function of lag time, are determined graphically by the relationship between observed discharges of consecutive days at time of recession of high waters for 160 sites and the runoff from rivers of the Dnieper, Southern Bug, Severskiy Donets and Azov Sca basins. It is suggested that lag time be computed from average lag velocity according to

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the Chezy-Mamming formula, which takes into account the shape and roughness of a channel and flood-plain, stream gradient and magnitude of maximum discharge. (See also W71-08374) (Josefson-USGS)

W71-08383

FIELD STUDIES OF THE INFILTRATION CAPACITY OF SOILS (RUSSIAN: O POLEVYKH ISSLEDOVANIYAKH VPI-TYVAYUSHCHEY SPOSOBNOSTI POCHVO-GRUNTOV).

N. G. Galushchenko.

In: Voprosy gidrologicheskikh prognozovi i raschetov, Ukrainskiy Nauchno-Issledovatel'skiy Gidrometeorologicheskiy Institut Trudy, No 76; p 92-98, 1969. 2 fig, 8 ref.

Descriptors: \*Infiltrometers, \*Infiltration, \*Artificial precipitation, \*Sprinkler irrigation, \*Soils, Watersheds (Basins), Topography, On-site investigations, Ravines, Forests, Permeability, Ru-

Identifiers: \*Ukraine, Artificial spinkling, Infiltra-

Experimental field studies of the infiltration capacity of soils on forested and field sections of the Boguslav Hydrologic Field Station were conducted by means of artificial sprinkling and flooded plots (infiltrometers). In a basin west of Boguslav, infiltrometers yielded values too high as compared with sprinkled plots. In forested areas the ratios obtained from infiltrometers during initial periods were usually 5-10 times those obtained by sprin-kling methods and, in individual cases, 60-100. In open areas the difference was less and did not ex-ceed 7-45. The difference in infiltration values from readings of flooded plots and artificial sprinkling decreased with time, amounting to 2-5 in the forest after 30-40 minutes and 2 in field areas. Readings of infiltrometers and sprinkled plots differed with respect to total depth of absorbed water and the time required for a steady infiltration value. Depending upon the sprinkling rate and its duration, the depth of absorbed water in forested areas was 2-10 times less from artificial sprinkling than from infiltrometers; in open areas the ratio was considerably less and in individual instances was equal to unity. In forested areas a relatively steady infiltration value during sprinkling was established 3-6 times more rapidly than in infiltrometers and in open areas the ratio of these time intervals did not exceed 2. An appreciable difference (10-11-fold) in infiltration values was also observed at the end of the third hour of experiments, using the two methods described. (See also W71-08374) (Josefson-USGS) W71-08384

#### DETERMINING PARAMETERS OF A UNIT HYDROGRAPH (RUSSIAN: K OPREDELENIYU PARAMETROV **ELEMENTARNOGO** GIDROGRAFA),

T. A. Chekushkina.

In: Voprosy gidrologicheskikh prognozov i raschetov, Ukrainskiy Nauchno-Issledovateľskiy Gidrometeorologicheskiy Institut Trudy, No 76; p 99-106, 1969. 2 fig, 3 tab, 5 ref.

Descriptors: \*Unit hydrographs, \*Discharge (Water), \*Watersheds (Basins), \*Time lag, Channel flow, Channel morphology, Chezy equation, Mannings equation, Roughness (Hydraulic),

Geomorphology.
Identifiers: \*Ukraine, Sozh River, Ingul River,
Berezina River, Isochrones, Travel time, Moklyak

Discharges of a high-water hydrograph can be quite accurately computed by using a unit hydrograph whose ordinates must be based on an accurate determination of the number of isochrones in a basin and the initial lag coefficients between isochrones. The value of the initial lag coefficient between isochrones for each specific basin may be assumed to be constant for a number of years of high water, since the pattern of increased discharges and drainage of a basin varies little under specific geomorphological conditions with minor fluctuations in high-water content. Ordinates of a unit hydrograph vary with change in lag time, which depends upon the magnitude of maximum discharge and redistribution of the coefficients of basin width. In similar-size hasins such as the lagur basin width. In similar-size basins such as the Ingul River basin near Novogorozheno and the Berezina near Borisov, channel flow may be variously formed, which calls for a careful approach to the problem of selecting initial lag coefficients as a function of the physico-geographic conditions of a In constructing a unit hydrograph for partially waterlogged basins it may be necessary to assume variables of the initial lag coefficients for reaches between isochrones in order to accurately account for the transformation characteristics of discharges for individual reaches of a river. (See also W71-08374) (Josefson-USGS) W71-08385

COMPUTING DISCHARGES OF HIGH WATER FROM PARTIAL BASINS BY UNIT HYDROGRAPHS (RUSSIAN: O VYCHISLENII RASKHODOV POLOVOD'YA PO ELEMENTARNYM GIDROGRAFAM S CHASTNYKH BASSEYNOV),
T. A. Chekushkina.
In: Voprosy gidrologicheskikh prognozov i raschetov, Ukrainskiy Nauchno-Issledovatel'skiy Gidrometeorologicheskiy Institut Trudy, No 76; p 107-111, 1969. 2 fig, 2 tab, 11 ref.

Descriptors: \*Discharge (Water), \*Unit hydrographs, \*Watersheds (Basins), Time lag, Reservoirs, Chezy equation, Mannings equation, Roughness (Hydraulic).
Identifiers: \*Ukraine, Seym River, Travel time, Lag

coefficients.

A possibility of obtaining high-water discharge values at a discharge site as a sum of individual hydrographs of partial basins is examined. To derive daily discharges, a unit hydrograph method is used in distributing lag coefficients along a model lag curve. The computation method cited yields satisfactory results and can be used to resolve problems associated with the separation of a basin into parts, particularly in studying the regulating effect of reservoirs in a basin on discharges at a site. For computation purposes, the Seym River basin, covering an area of 25,600 sq km, was used to compute discharge. A comparison of computation results showed that a total hydrograph derived by the summation of discharges from two partial basins was somewhat closer to a recorded hydrograph than a hydrograph determined for an entire basin as a whole. Future investigations will be directed at resolving the problem by dividing a whole basin into several sub-basins. (See also W71-08374) (Josefson-USGS) W71-08386

# A DEVICE FOR MEASURING RUNOFF FROM CROP ROTATION FIELDS (RUSSIAN: USTROYSTVO DLYA IZMERENIYA STOKA VODY NA POLYAKH SEVOOBOROTA), N. V. Pikush.

In: Voprosy gidrologicheskikh prognozov i raschetov, Ukrainskiy Nauchno-Issledovateľskiy Gidrometeorologicheskiy Institut Trudy, No 76; p112-115, 1969. 2 fig, 3 ref.

Descriptors: \*Flowmeters, \*Discharge measurement, \*Crops, \*Rotations, Instrumentation, Irrigation, Agriculture.

Identifiers: \*Ukraine, Dnepropetrovsk oblast, Crop rotation fields

Because of their simplicity and convenience and the fact that they do not interfere with agricultural work, a flowmeter or device for partial volumetric measurement of water discharge and runoff from crop rotation fields is recommended. Laboratory and on-site tests along with two years of experience in the use of a number of flowmeters on irrigation fields have revealed that flowmeters are reliable at even the lowest gradients, are relatively unaffected by silt and insure a water discharge measurement accuracy of plus or minus 3%. Runoff plots of 200 x 25 m equipped with flowmeters consisting of a tube 20-cm high and 10-cm wide, designed to permit discharges up to 20 liter/sec, have been in use in the Sofiyevka Rayon of the Dnepropetrovsk Oblast since 1965. Experience has shown that the device and operation of these plots are more expedient than hitherto used equipment. (See also W71-08374) (Josefson-USGS) W71-08387

# WATER RESOURCES AND WATER BALANCE OF THE UKRAINE AND MOLDAVIA (RUSSIAN: VODNYYE RESURSY I BALANS VODUKRAINY I MOLDAVII),

L. G. Onufriyenko.

In: Voprosy gidrologicheskikh prognozovi raschetov, Ukrainskiy Nauchno-Issledovatel'skiy Gidrometeorologicheskiy Institut Trudy, No 76; p 116-130, 1969. 5 fig, 6 tab, 13 ref.

Descriptors: \*Water balance, \*Water resources, \*Water consumption, \*Runoff forecasting, \*River basins, Moisture content, Runoff coefficient, Runof noff, Precipitation (Atmospheric), Evaporation, Watersheds (Basins), Meteorological data. Identifiers: \*Ukraine, \*Moldavia, Desna River, Tissa River, Dnieper River, Dniester River, Severskiy Donets River, Southern Bug River.

New runoff data computed from cyclic variations in water content and from the influence of economic activity on runoff were used to study the resources and water balance of river basins of the Ukraine and Moldavia and of individual physicogeographic zones. Resources were computed in connection with requirements for finding methods of preparing water balances for an average year and for low-water years of 75 and 95% probability. Local runoff for the Ukraine for an average year was 50.251 cu km and runoff entering the Ukraine from other republics 34.748 cu km; for Moldavia runoff values for an average year were 0.670 and 9.985 cu km, respectively. Precipitation, runoff and evaporation values for the Ukraine were 609 mm, 83 mm and 526 mm, respectively; for Moldavia these values were 517 mm, 20 mm and 497 mm. Water resources of the Ukraine represent only about 1.2% of the total figure for the Soviet Union and those of Moldavia only 1%, which for an average year equals 4,358 cu km. Projecting ahead, only the Desna and Tissa Rivers and their tributaries appear able to satisfy fully future water consumption needs. The water resources of the Dnieper and its tributaries--the Ros', Sula, Psel and Vorskla--and of the Western Bug, Seret and Prut rivers, while meeting annual water needs and providing sanitary disposal, fail to satisfy maximum seasonal requirements. The Dniester, Severskiy Donets, Mius, Kal'mius, Southern Bug and Ingul Rivers and rivers of the Crimea meet neither annual nor peak season demands. (See also W71-08374) (Josefson-USGS) W71-08388

# FLUCTUATIONS IN MINIMUM RUNOFF FOR RIVERS OF THE UKRAINE (RUSSIAN: KOLEBANIYA MINIMAL'NOGO STOKA REK UKRAINY),

K. A. Lysenko. In: Voprosy In: Voprosy gidrologicheskikh prognozovi raschetov, Ukrainskiy Nauchno-Issledovateľskiy Gidrometeorologicheskiy Institut Trudy, No 76; p 131-135, 1969. 1 fig 1 tab, 9 ref.

Descriptors: \*Runoff forecasting, \*Low flow, \*Surface-groundwater relationships, \*Hydorlogic cycle, Precipitation (Atmospheric), Rivers, Statistical methods.

Identifiers: \*Ukrainian rivers, Cyclic variations, Low-water periods, High-water periods.

In drawing up recommendations for computing minimum runoff for rivers of the Ukraine fluctua-

tions in minimum runoff were studied for determining maximum low-water periods within which lowest minimum runoff values are possible. Minimum discharges on small Ukrainian rivers are formed mainly by the inflow of groundwaters whose magnitude and yield are determined by atmospheric precipitation and other physico-geo-graphic factors. The greatest number of observations of minimum runoff in the Ukraine were conducted on the Desna, Severskiy Donets and Dniester Rivers for a period of 65-69 years and on the Styr', Tur'ya, Uzh, Sula, Southern Bug and Rov Rivers for 40-50 years. Integral curves of fluctuations in minimum runoff for the Desna, Severskiy Donets and Dniester Rivers revealed a successive nonperiodic alternation of high-water and lowwater periods (half cycles) of varied duration ranging from 8 to 46 years. Average water content for individual cycles for the period 1940-1962 deviated little from the average long-term value (by 0-9% and only in individual instances by as much as 13-14%). Long term changes in groundwater level were subjected to cyclic fluctuations wherein a were subjected to eyelle indectations wherein a synchronism in the fluctuations of minimum discharges of rivers and of groundwaters forming them could be seen. Study of long-term fluctuations in minimum runoff makes it possible to determine the maximum low-water period characteristic of rivers of a specific zone and to identify in this period the years which will have a rare recurrence of minimum runoff. (See also W71-08374) (Josefson-USGS) W71-08389

**OPTIMAL LENGTH OF REACH AND TIME IN-**OPTIMAL LENGTH OF REACH AND TIME INTERVAL IN COMPUTATIONS OF UNSTEADY MOVEMENT OF WATER USING THE METHOD OF G. P. KALININ AND P. I. MILYU-KOV (RUSSIAN: OPTIMAL'NYYE DLINA UCHASTKA I INTERVAL VREMENI PRI RASCHETAKH NEUSTANOVIVSHEGOSYA DVIZHENIYA VODY PO METODU G. P. KALININA I P. I. MILYUKOVA),

LA Zhelzanak and A I. Shereshovskiv I. A. Zheleznyak, and A. I. Shereshevskiy.

In: Voprosy gidrologicheskikh prognozovi i raschetov, Ukrainskiy Nauchno-Issledovatel'skiy Gidrometeorologicheskiy Institut Trudy, No 76; p 136-143, 1969. 2 fig. 1 tab, 5 ref.

Descriptors: \*Waves (Water), \*Time lag, \*Runoff, \*Discharge (Water), \*Design data, Hydrographs, Mathematical studies, Design flood, Design flow. Identifiers: \*Ukraine, Water movement.

The reliability of simplified computations of the movement of flood waves using the Kalinin-Milyukov method can be substantially increased if adjusted values of runoff for typical reaches are replaced by computations for design reaches. Such a substitution is particularly desirable when lag time within a typical reach is more than the design time interval. Computations of water movement for reaches whose length has been determined by discharges within the entire range of their changes and the observance of the condition 'delta t is approximately equal to lag time' permit computations to be performed with a maximum possible accuracy for simplified computations, and insure coincidence in time and magnitude of maximum and minimum water discharges. It would be inadvisable to perform computations when delta t is much less than lag time, since a computation for small design time intervals with a relatively smooth change in discharges, while increasing volume of computa-tions, does not increase their reliability. One may assume delta t to be much more than lag time only when the design interval describes in sufficient detail the rate of discharges during a flood period. Data from field observations of the movement of flood waves downstream from the dam of the Ivan'kovskaya Hydroelectric Powerplant in August 1938 were used as a basis for computations. (See also W71-8374) (Josefson-USGS) W71-08390

SELECTION OF OPTIMUM PLAN FOR IM-NASSAU, PROVEMENTS IN

PROVIDENCES, BAHAMAS. MODEL INVESTIGATION, HYDRAULIC

Army Engineer Waterways Experiment Station, Vicksburg, Miss. For primary bibliographic entry see Field 08B. W71-08510

STABILITY OF RIPRAP AND DISCHARGE CHARACTERISTICS, OVERFLOW EMBANK-MENTS, ARKANSAS RIVER, ARKANSAS: HYDRAULIC MODEL INVESTIGATION, Army Engineer Waterways Experiment Station.

Vicksburg, Miss. For primary bibliographic entry see Field 08B. W71-08514

# DEVELOPMENT OF WATER RESOURCES IN THE KHMER REPUBLIC.

Economic Commission for Asia and the Far East. New York.

Water Resources Journal, United Nations Economic Commission for Asia and the Far East (ST/ECAFE/SER. C/87), p 1-44, Dec 1970. 44 p, 10 fig, 12 tab, 9 ref.

Descriptors: \*Water resources development, \*Planning, \*River basin development, Deltas, Rivers, Water supply, Water management (Applied), Monsoons, Flood control, Dams, Reservoirs, Hydroelectric power, Irrigation water. Identifiers: \*Khmer Republic, \*Indochinese Penin-

The Khmer Republic is situated in the southwestern corner of the Indochinese peninsula. The dominant geographical feature is the Mckong river which plunges over the Khone Falls at the border with Laos and courses through many rapids between the town of Khone and Kratic before between the town of Khone and Kratte before gradually becoming wider and less turbulent and flowing in a generally southerly direction through the eastern part of the central Khmer plain. South of Phnom Penh, the capital, it splits into two branches, the eastern branch continuing to be known as the Mekong, while the western branch is named the Bassac river. It is estimated that as many as 4 million people, or more than 60% of the total population, do not have access to piped water supplies. The development of the water resources of the Khmer Republic cannot be separated from the comprehensive development of the entire lower Mekong basin, which is being implemented under the Mekong project. A brief description is given of the status of the major mainstream and tributary projects in the Khmer Republic under the Mekong Indicative Basin Plan. (Knapp-USGS) W71-08546

# EFFECT OF LAND USE ON THE HYDROLOGY OF SMALL WATERSHEDS SOUTHWESTERN WISCONSIN,

North Central Forest Experiment Station, La

Symposium on the Results of Research on Oyimposium on the Results of Research on Representative and Experimental Basins, Welling-ton, New Zealand, December 1-8, 1970. Publica-tion No 96, International Association of Scientific Hydrology, p 286-295.

Descriptors: \*Storm structure, \*Rainfall disposition, \*Small watersheds, \*Sediment yield, Agricultural watersheds, Forestry, Unit hydrographs, Land use, Wisconsin, Overland flow, Storm runoff. Identifiers: Experimental watersheds.

Overland flow and sediment discharge were measured on small single land use watersheds and natural runoff plots in southwestern Wisconsin's unglaciated region. Forest watersheds produced over-land flow only after heavy rains, and the amounts of flow and peak rates were low compared with those from open-land watersheds. Peak flow rates from a major storm ranged from 64 millimeters per hour for tilled land to no flow for undisturbed forest. Analysis of the flows from five large storms in I year showed that peak rates from tilled land averaged 2.5 times those from meadow, and peak rates from meadow 1.4 times those from an abandoned field. Peak rates from heavily grazed pasture were 3.0 times those from lightly grazed pasture.
Suspended sediment content of the runoff water Suspended sediment content of the runoff water ranged from 238,000 parts per million for tilled land to 0 parts per million for undisturbed forest. Sediment content was low for forest, abandoned field, and meadow, but high for tilled land and heavily grazed pasture. W71-08839

WATER QUALITY MANAGEMENT DATA AS-SOCIATED WITH RESERVOIR OPERATIONS, Corps of Engineers, Washington, D.C. For primary bibliographic entry see Field 05A.

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN NEW YORK.

Corps of Engineers, New York. North Atlantic Div.

Army Corps of Engineers Water Resources Development Report, Jan 1971. 153 p.

Descriptors: \*Water resources development, \*New York, \*Engineering structures, Surface waters, Navigation, Navigable waters, Bridges, Flood control, Reservoirs, Beach erosion, Dams, Hurricanes, St Lawrence Seaway, Sedimentation. Identifiers: Niagra River, Niagra Falls.

This report provides current information on the scope and progress of water resources development within the State of New York by the United States Army Corps of Engineers. It describes briefly the Corps' role in planning and building these improve-ments and includes an explanation of the procedure for initiating and processing them. Infor-mation is given on the status of the various projects, whether the work is completed, is underway, or has not been started. The projects are concerned with navigation, alteration of bridges over navigable waterways, flood control, reservoirs, lakes, beach erosion, hurricane protection, St. Lawrence Seaway, and Niagra remedial works. (Woodard-USGS W71-08902

### GENERAL HYDRAULIC SYSTEM MODEL,

Illinois Univ., Urbana. Dept. of Hydraulic Engineering; and Madras Univ., India College of En-

yen Te Chow, and V. C. Kulandaiswamy.

ASCE Proceedings, Journal of the Hydraulic Division, Vol 97, No HY6, Paper 8176, p 791-804, June 1971, 14 p, 4 fig, 1 tab, 8 ref, append.

Descriptors: \*Simulation analysis, \*Mathematical models, \*Numerical analysis, \*Systems analysis, \*Flood forecasting, Streamflow forecasting, Model studies, Routing, Input-output analysis, Peak discharge, Runoff, Storm runoff, Unit hydrographs, Hydrograph analysis, Design storm, Design flow, Design flood.

Hydrologic models, Hydrograph Identifiers:

A lumped, deterministic, nonlinear mathematical model is developed and proposed for the simulation of hydrologic systems. The model is developed from expansion of a general storage function of input and output in Taylor's series about a steady state. The model recommended for practical appli-cation is based on the system model in the form of a third-order differential equation, It is a quasi-non-linear model because the coefficients of the differential equation are considered as functions of the peak discharge of direct runoff. In the analysis of the model, watershed is taken as the hydrologic system. Nine watersheds with more than 70 major and minor storms were used in the analysis and verification of the recommended model. The

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results indicate a very satisfactory simulation of watershed hydrologic systems by the model. (K-napp-USGS)
W71-08909

FLOOD PLAIN INFORM BRANCH BRANDYWINE CREEK. **INFORMATION-WEST** Corps of Engineers, Philadelphia, Pa

Army Corps of Engineers Flood Plain Report, Mar 1970. 48 p, 5 fig, 16 plate, 9 tab.

Descriptors: \*Floods, \*Flood damage, \*Pennsylvania, Flood plains, Regional flood, Flood forecasting, Flood control, Historic flood.

Identifiers: \*West Branch Brandywine Creek,

\*Chester County (Penn), Standard project flood, Intermediate regional flood.

Flooding along the West Branch Brandywine Creek from the junction of the East and West Branches in the southeast portion of Chester County upstream to the northern limits of the City of Coatesville, Pennsylvania is described to aid in solving local Pennsylvania is described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections, and text material relating the extent of past flooding to floods which might occur in the future are based on available records of rainfall, runoff, historical flood heights and other technical data. Flood stages can rise from normal flow to extreme Flood stages can rise from normal flow to extreme peaks in a relatively short period of time. During the flood of August 9, 1942 the West Branch Brandywine Creek in the Coatesville area had a maximum rate of rise of 7 feet per hour and remained out of banks for about 9 hours. During a Standard Project Flood at the same location, the stream would rise 18 feet in 10 hours and would remain out of banks for about 30 hours. (Woodard-USGS) W71-08911 W71-08911

# FLOOD CONTROL STUDY OF RIO GRANDE DE MANATI, MANATI AND BARCELONETA, PUERTO RICO.

Flavio Acaron and Associates, San Juan (Puerto

Available from the National Technical Information Service as PB-196 488, \$3.00 in paper copy, \$0.95 in microfiche. Flavio Acaron and Associates Consulting Engineers Flood Control Report, June 1970. 123 p, 43 exh, 42 tab, 15 ref.

Descriptors: \*Flood control, \*Flood protection, \*Flood damage, \*Flood plains, \*Puerto Rico, Regional flood, Flood forecasting, Watershed management, Levees, Flood forecasting, Watershed management, Levees, Flood routing, Hurricanes, Streamflow, Runoff, Channel improvement

Flooding along the Rio Grande de Manati watershed in Puerto Rico is described to aid in solving flood control problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections and other material relating the extent of past flooding to floods which might occur in the future are based on available records of rainfall, runoff, historical flood heights and other technical data. The principal cause of major flooding has been the passage of hurricanes and of tropical disturbances over or near the island of Puerto Rico: however, in some occasions concentrated abnormal rainfall has caused flood stages that have been equal to or greater than those generated by rainfall during the passage of hurricanes and of tropical disturbances. To achieve an effective flood control plan, several structures and raeasures are described. (Woodard-USGS) W71-08919

THE RUNOFF REGIME DURING SUBSURFACE DRAINAGE OF PEAT BOGS (RUSSIAN:
REZHIM STOKA PRI OSUSHENII TORFYANIKOV ZAKRYTYM DRENAZHEM),
Vsesoyuznyi Nauchno-Issledovatelskii Institut
Gidrotekhniki i Melioratsii, Moscow (USSR).

V Ya. Chernenok. Gidrotekhnika i Melioratsiya, No 1, p 66-69, January 1971. 4 p, 2 fig, 3 tab.

Descriptors: \*Runoff, \*Subsurface drainage, \*Subsurface drains, \*Bogs, \*Drainage effects, Soils, Discharge (Water), Seasonal, Precipitation (Atmospheric), Porbability. Identifiers: \*USSR, Peat bogs, Water regime,

Growing season, Bog drainage.

Studies conducted in 1961-69 on the Yakhroma Studies conducted in 1961-69 on the Yakhroma River floodplain have established that maximum discharges of 10% probability during subsurface drainage of peat bogs with drains at a depth of 1.7-2.0 m and spaced 20 and 40 m apart were 0.66 and 0.58 liter/sec/ha: maximum discharges during the presowing season were 0.45 and 0.44 liter/sec/ha, respectively. Maximum discharges of 10% probability during subsurface drainage with drains at bility during subsurface drainage with drains at depths of 0.8-1.2 m and spaced 20 and 40 m apart were 0.81 and 0.79 liter/sec/ha, with maximum discharges during the presowing season 0.56 and 0.67 liter/sec/ha, respectively. Average monthly discharges for the May-September periods from 1962-69 during subsurface deainage of peat bogs did not average 0.2 liter/sec did not exceed 0.2 liter/sec/ha. A maximum discharge of 1.64 liter/sec/ha was observed in June discharge of 1.64 liter/sec/ha was observed in June 1965 in an area of intense precipitation (56.3 mm), where drains had been placed to depths of 0.8-1.2 m and set 20 m apart. Macimum discharges of 1-10% probability during subsurface drainage to depths of 1.7-2.0 m with drains 20 and 40 m apart were 24-27% lower than values obtained from installing drains to a depth of 0.8-1.2 m. (Josefson-USGS) W71-08934

## 4B. Groundwater Management

WATER RESOURCES IN THE UPPER STONES RIVER BASIN, CENTRAL TENNESSEE, Geological Survey, Nashville, Tenn. For primary bibliographic entry see Field 02F. W71-08330

WATER RESOURCES OF WARD COUNTY. TEXAS,

Geological Survey, Austin, Tex. For primary bibliographic entry see Field 02F. W71-08331

THE USE OF WELL LOGGING IN RECHARGE STUDIES OF THE OGALLALA FORMATION. Geological Survey, Lubbock, Tex. For primary bibliographic entry see Field 02F. W71-08352

NOTE ON HYDROLOGICAL RESEARCH IN BOTSWANA WITH SPECIAL EMPHASIS ON RESEARCH IN THE HYDROGEOLOGICAL FIELD,

Botswana Geological Survey, Lobatse. C. M. H. Jennings. South African Journal of Science, Vol 67, No 1, p 12-21, Jan 1971. 1 fig, 13 ref.

Descriptors: \*Hydrogeology, \*Groundwater basins, \*Borcholes, \*Semiarid climates, \*Subsur-\*Groundwater face investigations, On-site investigations, Drainage basins, Climatic data, United Nations, Aquifers.

Identifiers: \*Botswana, \*Kalahari Desert.

Botswana, located in southern Africa, is a vast semiarid tableland with erratic rainfall. A few rivers in the north are perennial, but most drainages are ephemeral. Arable soils suitable for irrigation are too far from the northern area waters to allow for economical pumping schemes. The agricultural potential of the nation is therefore limited, and the major industry is cattle raising. Both cattle and men are dependent upon groundwater supplies that are rapidly becoming depleted. Mineral finds have been made, indicating the potential of a mining industry if water supplies are adequate. A great deal of hydrogeological research has been carried out in recent years and observation boreholes have been developed. Borehole water level measurements combined with data on rainfall and groundwater combined with data on rainfail and groundwater consumption have yielded information on safe yields, infiltration rates, transmissibility and storage capacity. C-14 and stable isotope studies in certain Kalahari ranching areas should yield data on age and origin of groundwaters as well as aquifer characteristics. (Casey-Arizona)

PUBLIC HEALTH ASPECTS OF INDIVIDUAL WATER WELLS,
Monroe County Health Dept., Mich.

For primary bibliographic entry see Field 05G.

ESTIMATED WATER USE IN NEVADA,
Geological Survey, Carson City, Nev.; and Nevada
State Dept. of Conservation and Natural
Resources, Carson City. For primary bibliographic entry see Field 06D. W71-08526

USE OF WELLS AND PITS TO RECHARGE UNDERGROUND FORMATIONS IN SEMI-ARID AREAS,

Texas Tech Univ., Lubbock, Tex. Dept. of Agricul-

tural Engineering. Marvin J. Dvoracek

Marvin J. Dvoracek.

Available from the National Technical Information
Service as PB-199 829, \$3.00 in paper copy, \$0.95
in microfiche. Paper presented at International
Conference on Arid Lands in a Changing World, June 3-13, 1969, Arizona University, Tucson. 13 p, 14 ref. OWRR Project B-041-TEX (1).

Descriptors: \*Artificial recharge, \*Pit recharge, \*Groundwater recharge, \*Natural recharge, \*Water reuse, Water wells, Multiple-purpose reservoirs, Induced infiltrations, Reclaimed water, Injecvois, induced infirtations, Reclaimed water, injection, Recharge wells, Inflow, Diffusivity, Aquifer characteristics, Confined water, Groundwater basins, Hydrogeology, Permeability, Porosity, Porous media, Specific retention, Underground storage, Water sources.

Identifiers: Imported water, \*Sub-surface water

A general discussion is given of the different methods that can be employed in artificial groundwater recharge in semi-arid areas. Emphasis is placed on the need to collect and retain large amounts of summer rainfall before it is lost through mass evaporation and surface runoff. The use of wells and specially constructed pits in addition to trenches and rubble cones as collection reservoirs for artificial groundwater recharge is discussed and suggested. (Glasby-USGS) W71-08534

#### THE PROTECTION OF GROUNDWATER RESOURCES.

Water Well Journal, Vol 24, No 7, p 31-33, July 1970.3 p.

Descriptors: \*Groundwater, \*Water resources development, \*Water wells, \*Water quality condevelopment, water wells, water quality con-trol, \*Hydrogeology, Reviews, Water management (Applied), Governments, Water conservation, Water supply, Regulation, Aquifers, Injection wells, Water pollution sources. Identifiers: \*Groundwater protection.

Information concerning protection of groundwater resources was assembled from many authoritative sources and reviewed under the following main topics: (1) the protection of groundwater resources; (2) the availability and use of groundwater; (3) the classification of groundwater pollutants; (4) groundwater pollution from surface sources; (5) groundwater pollution from produc-

#### WATER QUANTITY MANAGEMENT AND CONTROL—Field 04

#### Groundwater Management—Group 4B

tion wells; (6) groundwater pollution from injection wells; (0) groundwater pollution from injec-tion wells; (7) the purification of polluted ground-water; (8) the role of federal legislation; (9) governmental responsibilities in groundwater management; and (10) sharing the responsibility. (Woodard-USGS) W71-08542

#### THE HYDROGEOLOGICAL INVESTIGATION OF FISSURE-FLOW BY BOREHOLE LOGGING TECHNIQUES,

Institute of Geological Sciences, London (England). Dept. of Hydrogeology. For primary bibliographic entry see Field 02F. W71-08547

## SOME ASPECTS OF THE TRIASSIC AQUIFER IN EAST DEVON AND WEST SOMERSET, Sherrell (Frederick) Engineering Geologists,

Tavistock (England).
For primary bibliographic entry see Field 02F.
W71-08548

#### A CONTRIBUTION TO THE ANALYSIS OF RECOVERY DATA FOR THE DETERMINATION OF THE HYDRAULIC PROPERTIES OF AN AQUIFER,

Geological Survey of Denmark, Copenhagen Zvonimir Haman, and Lars Jorgen Anderson Denmark Geological Survey, Series 3, No 37, 1970. 24 p, 7 fig, 2 tab, 8 ref.

Descriptors: \*Groundwater, \*Pumping, \*Aquifer characteristics, \*Hydraulic properties, \*Recharge, Transmissivity, Storage coefficient, Aquifers, Mathematical studies, Equations, Withdrawal, Drawdown, Analytical techniques, Artesian wells, Water levels, Barometric efficiency, Atmospheric

Identifiers: \*Aquifer tests, \*Aquifer evaluation, \*Pumping tests.

A reliable calculation of hydraulic properties (coefficients of transmissivity and storage for the drawdown data of an aquifer) utilizes recovery data instead of residual drawdown data. A useful formula computes the recovery from the extrapolated drawdown. Data were obtained from a pumping test in an artesian aquifer at Hvinningdal, Sil-keborg, Denmark. The calculations were made by means of the nonequilibrium formulas of Theis and Jacob. In addition, procedures and examples of adjustments of water-level data for barometric efficiency are given. (Woodard-USGS) W71-08549

## BASIN RECHARGING THE OGALLALA AQUIFER THROUGH PLEISTOCENE SEDI-

Agricultural Research Service, Bushland, Tex. Soil and Water Conservation Research Div.

V. S. Aronovici, Arland D. Schneider, and Ordie R.

In: The Ogallala Aquifer--A Symposium, Texas Tech University, Lubbock, International Center for Arid and Semi-Arid Land Studies Special Report No 39, p 182-192, 1970. 11 p, 4 fig. 10 ref.

Descriptors: \*Pit recharge, \*Infiltration, \*Texas, \*Aquifers, Alluvium, Permeability, Unsaturated flow, Artificial recharge, Groundwater recharge, Percolation, Water spreading, On-site tests, Hydrogeology. Identifiers: \*Ogallala aquifer (Texas).

Recharge in permeable hardland soils of the High Plains of Texas is negligible, and the Ogallala aguifer is cut off from any other appreciable water source. The relief of the hardlands is characterized by numerous playas or depressions in which most storm runoff collects. The playa bottoms are usually blanketed with clay, which retards downward percolation. Between 1.8 and 5.7 million acre-feet annually are wasted by evaporation from playas. A site 600 feet from a playa at

Bushland, Texas, was used for basin recharge tests. Two 66-foot square basins with 1:1 side slopes were excavated to expose the unconsolidated caliche layer approximately 4 feet below ground surface.

Neutron moisture meter access tubes and several piezometers were installed. Playa water containing suspended solids was applied. Percolation rates rose until 0.92 pound of sediment per square foot of basin was added. Suspended solids definitely reduced percolation rates, but zooplankton may have had an equally important influence. The main advantage of basin recharge is the relative low cost and ease of sediment removal should it be necessary. (See also W71-08349 thru W71-08357) (K-napp-USGS) W71-08570

#### WATER TRANSFER AT BEDROCK-ALLUVI-UM CONTACTS.

Colorado State Univ., Fort Collins. Dept. of Geolo-

gy. For primary bibliographic entry see Field 02F. W71-08572

#### PROBLEMS OF ARTIFICALLY RECHARGING THE OGA OGALLALA FORMATION

Geological Survey, Denver, Colo. C. T. Jenkins, and W. E. Hofstra.

C. T. Jenkins, and W. E. Hotstra.

In: The Ogallala Aquifer--A Symposium, Texas
Tech University, Lubbock, International Center for
Arid and Semi-Arid Land Studies Special Report
No 39, p 154-164, 1970. 11 p, 5 fig, 5 ref.

Descriptors: \*Artificial recharge, \*Colorado, \*Aquifers, \*Alluvium, Infiltration, Alluvial channels, Water spreading, Permeability, Transmissivity, On-site tests, Rainfall, Water supply, Playas, Water conservation, Water reuse, Hydrogeology. Identifiers: \*Ogallala aquifer (Colorado)

Two studies relating to artificial recharge were made by the U. S. Geological Survey in the northern High Plains of Colorado in 1969. The studies consisted of an evaluation of water available in Kit Carson County, Colorado, and test drilling near Akron, Colorado. Less than 1 percent of the average annual precipitation, which is about 16 inches, leaves the area as surface runoff. This limited amount of water available for increasing recharge probably precludes the construction of large recharge projects. However, the study indicated that significant natural recharge occurs in some ephemeral stream channels. The test-drilling study showed that many poorly permeable lenses within the Ogallala Formation inhibit recharge. Some water might be salvaged from playas either by pumping the water for reuse onto cropped land or by recharging it to the aquifer through wells. (See also W71-08349 thru W71-08357) (Knapp-USGS) W71-08574

WASTE OF ARTESIAN WATERS IN EAST STYRIA (GERMAN: RAUBBAU AN ARTE-SISCHEM WASSER IN DER OSTSTEIER-MARK).

Technische Hochschule, Graz (Austria). Institut fuer Mineralogie und Technische Geologie. F. Ronner, and J. Schmied.

English abstract. Steirische Beitrage zur Hydrogeologie, No 20, Graz, p 63-80, 1968. 18 p, 1

Descriptors: \*Artesian wells, \*Water yield, \*Hydrogeology, Groundwater movement, Water utilization, Irrigation water, Water loss, Confined water, Water levels, Water table, Consumptive use, Water law, Water rights, Water balance. Identifiers: \*Styria (Austria), \*Austria.

In the tertiary basin of Styria and southern Burgenland, 287 flowing and 51 non-flowing artesian wells produce water which largely runs off unused. The 287 flowing wells yield about 3280 cu m per day. From these, a population of 1550 and their ir-

rigated farms are supplied. Daily consumption is about 110 liters per person. The balance of 3,116,000 liters per day runs off unused, which means that 5% is actually consumed and 95% is wasted. It is possible that the limits of safe yield have already been overstepped. According to the Austrial Water Law of 1959 artesian wells must be reported to, and approved by, the authorities, but the law contains no definition of the term 'artesian well'. (Knapp-USGS).
W71-08579

GROUNDWATER IRRIGATION IN THE TIRASPOL' DISTRICT OF MOLDAVIA (RUSSIAN: OROSHENIYE PODZEMNYMI VODAMI V TIRASPOL'SKOM RAYONE MOLDAVII), For primary bibliographic entry see Field 02F. W71-08582

TELEVISION - A NEW TOOL FOR THE GROUNDWATER GEOLOGIST, Geological Survey, Washington, D.C. J. T. Callahan, R. L. Wait, and M. J. McCollum. Ground Water, Vol 1, No 4, p 4-6, Oct 1963. 9 fig.

Descriptors: \*Water wells, Casing, Screens, Drilling, Lithology, Aquifer characteristics, Groundwater, Rock properties. Identifiers: \*Television, 'Subaqueous' geologic studies. Drilling characteristics.

The television camera has become a tool of the groundwater geologist, enabling him to examine visually the inside of a well deep below the land surface. Using the camera, the rocks can be viewed in place. Of great importance to the groundwater studies in coastal Georgia, the camera enables the geologist to see the important water-bearing zones in a limestone aquifer, and to recognize cracks and solution cavities, the changes in geologic formations, and the irregularities in the well bore that indicate the relative hardness of the rocks. The engineer, well driller, and water developer can examine a well when 'trouble shooting' to see whether the casing is broken, whether screens are eroded, or whether the well contains obstructions. (Campbell-NWWA) W71-08815

#### HOW TO COMPLETE WATER SOURCE WELLS,

Marathon Oil Co., Regina (Saskatchewan) For primary bibliographic entry see Field 08A.

#### VOLUME OF SNOWMELT INTERCEPTED BY LOGGING ROADS,

Southern Forest Experiment Station, Oxford, Miss. Edward R. Burroughs, Jr., Michael A. Marsden, and Harold F. Haupt.
ASCE National Water Resources Engineering

Meeting, Phoenix, Arizona, Jan 11-15, 1971. Preprint 1326, 23 p.

Descriptors: \*Snowpacks, \*Snowmelt, \*Runoff, \*Lumbering, Overland flow, Interception, Mountains, Watersheds (Basins), Melt water, Snow management, Idaho, Montana.

Identifiers: \*Shallow subsurface flow, Interface flow, Lochsa River headwaters.

During an average snowpack season at high elevation in the Bitterroot Mountains of Montana and Idaho (a) the daily hydrograph for melt water collected in a roadway follows the classical diurnal pattern of high daytime and very low nighttime flow; (b) a larger portion of the daily volume seeps from the roadbank as shallow subsurface flow while a smaller portion flows directly over the ground surface beneath the snowpack; and (c) the daily combined volume of flow can be of considerable magnitude in terms of acre-feet. W71-08848

#### Field 04-WATER QUANTITY MANAGEMENT AND CONTROL

#### Group 4B—Groundwater Management

USE OF RADIOISOTOPES IN TRACING RESERVOIR LEAKAGE AT ANCHOR DAM, Bureau of Reclamation, Denver, Colo. Chemical

Engineering Branch.
For primary bibliographic entry see Field 08B. W71-08863

#### THE TEXAS WATER DEVELOPMENT BOARD COOPERATIVE STUDIES OF THE OGALLALA UNDERGROUND RESERVOIR,

Texas Water Development Board, Austin. Ground-

For primary bibliographic entry see Field 02F.

#### APPLICATION OF SURFACE PRESSURE TO ASSIST WATER RECHARGE INTO THE OGALLALA FORMATION,

Texas Tech Univ., Lubbock. Dept. of Petroleum

Philip Johnson.

In: The Ogallala Aquifer--A Symposium, Texas Tech University, Lubbock, International Center for Arid and Semi-Arid Land Studies Special Report No 39, p 193-204, 1970. 12 p, 8 fig.

Descriptors: \*Groundwater recharge, \*Injection wells, \*Aquifers, \*Texas, Water management (Apwens, "Additers, "Texas, water management (Applied), Recharge, Permeability, Water wells, Groundwater movement, Water levels, Water storage, Water yeild, Hydrogeology. Identifiers: \*Ogallala aquifer (Texas).

Large volumes of water may be stored in the dewatered zones of the Ogallala aquifer in Texas and may be retained in the vicinity of recharge for a reasonable period of time to permit local usage. Costs to recharge the Ogallala aquifer with playa water or imported water are reasonable with modern pumping equipment. Rapid disposal of playa lake water permits maximum utilization of the land for farm use. Sustained high flow rates into a recharge well may be obtained by application of pump pressure at the surface. Estimated costs to drill and equip a recharge well with a turbine sump pump and electric power equipment capable of injecting 1700 GPM at 50 psig pressure total \$3,969. (See also W71-08349 thru W71-08357 and W71-08570 thru W71-08575) (Knapp-USGS)

#### RECHARGING THE OGALLALA FORMATION USING SHALLOW HOLES,

Texas Tech Univ., Lubbock. Dept. of Agricultural Engineering

Marvin J. Dvoracek, and Sam H. Peterson.

In: The Ogallala Aquifer--A Symposium, Texas Tech University, Lubbock, International Center for Arid and Semi-Arid Land Studies Special Report No 39, p 205-218, 1970, 14 p, 7 fig, 1 tab, 15 ref.

Descriptors: \*Groundwater recharge, \*Injection wells, \*Aquifers, \*Texas, Water management (Applied), Recharge, Permeability, Water wells, Groundwater movement, Water levels, Water storage, Water yield, Hydrogeology. Identifiers: \*Ogallala Aquifer (Texas).

More than fifteen acre-feet of runoff water has been recharged into the Ogallala aquifer of Texas by means of a shallow hole. During this period increased in rate of recharge were observed. A condition of soil piping is responsible for the increasing rates and disposition of the cavity material. By soil piping, the more water recharged the greater the channel sizes become, accommodating more water and more sediment. In conclusion, recharge by this method has proven to be an effective means of artificially recharging the Ogallala Formation in the area of the test. (See also W71-08349 thru W71-08357 and W71-08570 thru W71-08575) (Knapp-USGS)

W71-08897

GROUNDWATER CONDITIONS IN HARQUAHALA PLAINS, MARICOPA AND YUMA COUNTIES, ARIZONA,

Geological Survey, Phoenix, Ariz.

Arizona Land Department Water Resources Report, No 45, Apr 1971. 44 p, 7 fig, 2 plate, 4 tab, 7 ref, append.

Descriptors: \*Groundwater, \*Irrigation wells, \*Hydrologic data, \*Data collections, \*Arizona, Aquifer characteristics, Water yield, Withdrawal, Aquifers, Water quality, Chemical analysis, Hydrogeology, Water wells, Water levels, Drawdown, Irrigation, Agriculture, Crops, Reviews. Identifiers: \*Groundwater resources, \*Maricopa (Ariz), \*Yuma County \*Harquahala Plains (Ariz), Drillers logs

The climate in the Harquahala Plains in Arizona is arid, and precipitation is inadequate for raising crops; therefore, the groundwater reservoir is the only dependable source of water for irrigation. The first large irrigation well was drilled in 1951. In December 1966, 39,500 acres were under cultivation, and about 120 irrigation wells were in use. Most of the cultivated land is in the southeastern part of the area. The principal water-bearing strata are the sand and gravel units in the alluvium that underlies the plains. From December 1963 to December 1966, the water level declined as much as 50 feet. During this time about 3.7 million acrefeet of sediments was dewatered as a result of the withdrawal of about 560,000 acre-feet of groundwater. These data indicate a storage coefficient of about 0.15 for the aquifer. About 7.4 million acrefeet of water is available for withdrawal from the groundwater reservoir in the southeastern part of the Harquahala Plains. Chemical analyses indicate that the dissolved-solids content of the water ranges from about 500 to more than 1,000 mg/l. (Woodard-USGS) W71-08900

#### PROJECTED GROUNDWATER DEFICIENCIES IN NORTHEASTERN ILLINOIS, 1980-2020,

Illinois State Water Survey, Urbana. R. J. Schicht, and Allen Moench.

Illinois Water Survey Circular 101, 1971. 22 p, 10 fig, 3 tab, 11 ref.

Descriptors: \*Water demand, \*Water supply, \*Water shortage, \*Groundwater mining, \*Illinois, Safe yield, Water yield, Aquifers, Water resources development, Overdraft, Water utilization, Withdrawal, Forecasting, Groundwater. Identifiers: \*Chicago (III).

Future groundwater demands for each township in the Chicago Region were estimated for each 10-year interval from 1980 to 2020. Relationships were found between population and per capita consumption and between manufacturing employment and per capita consumption. Estimates of demand were made on the basis of these relationships. Groundwater resources are developed from two aquifer systems. Future demands were compared with the available groundwater resource for each township, and maps were prepared showing areas of groundwater deficiency. When limiting ground-water withdrawals to recharge, a large number of townships will require importation of water by as early as 1980. By continued mining, three townships in northern Cook County will require importation by 1990. Large areas will require importation by 2020 with either approach. It is possible there is sufficient water in storage in the deeper aquifers to meet groundwater demands through 2020. (Knapp-USGS) W71-08906

#### THE YIELD OF WATER WELLS.

Universal Oil Products, St. Paul, Minn. Johnson

U.O.P. Johnson Division Bulletin No. 1238, Revised February, 1962, 8 p., 5 fig.

Descriptors: \*Water wells, \*Sepcific yield, Drawdown, Hydraulic gradient, Screens.
Identifiers: \*Head loss, Well design factors, Well discharge formulas, Well diameter effects, Well spacing, Yield-drawdown relations.

The potential capacity of a water-bearing sand or sand-gravel formation to yield water is governed primarily by the permeability, extent and thickness of the formation. Development of the full yielding capacity of the aquifer by the construction of screened wells depends on the depth of penetration, screen design, drawdown, method of development and to a limited extent on well diameter. There are other technical details of ground water hydraulics and hydrology that might be discussed. However, the presentation of the fundamental principles in this bulletin will serve as a reliable guide for choosing the various elements of the well struc-ture to get the desired end results -- maximum yield and efficient operation. (Campbell-NWWA) W71-08923

#### 4C. Effects on Water of Man's Non-Water Activities

NATIONAL HYDROLOGIC BENCH-

MARK NETWORK, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 07A.

#### A STUDY OF RESOURCE USE IN URBANIZING WATERSHEDS, Harvard Univ., Cambridge, Mass. Dept. of Land-

scape Architecture.

Peter Rogers, and Carl Steinitz.

Available from the National Technical Information Service as AD-719 311, \$3.00 in paper copy, \$0.95 in microfiche. Corps of Engineers Plan Formula-tion and Evaluation StudiesEnvironmental Analysis Contract Report No 2, June 1970.

Descriptors: \*City planning, \*Urbanization, \*Environmental affects, \*Watersheds, Mathematical models, Drainage systems, Water pollution rivers, River basins, Landscaping. Identifiers: Urban hydrology

The report describes a simulation model constructed to enable planners to evaluate quickly the damaging impact of urbanization (and changing land uses) on the run-off characteristics of a river basin. The model area involves a small part of the Charles River Basin, Massachusetts. It also deals with visual consequences of urbanization upon waterways which flow through the developing area. W71-08513

#### SPACE-TIME VALIDATION OF A THUN-

DERSTORM RAINFALL MODEL, Arizona Univ., Tucson. Dept. of Watershed Management. For primary bibliographic entry see Field 02B. W71-08530

#### STREAM SEDIMENT: AN ENVIRONMENTAL

PROBLEM,
Geological Survey, Washington, D.C. Water Resources Div.

George E. Ferguson, and Harold P. Guy.

Journal of Soil and Water Conservation, Vol 25, No 6, p 217-221, Nov-Dec 1970. 3 tab, 2 fig, 19

Descriptors: \*Sediment transport, \*Sediment control, Road construction, Costs, Urbanization, Erosion control, Construction. Identifiers: \*James River Basin, Interstate Commis-

sion on the Potomac River Basin.

Although the problem of sediment runoff is an old one, people have been aroused recently because of

#### WATER QUANTITY MANAGEMENT AND CONTROL—Field 04

D. C. McClurkin.

#### Watershed Protection—Group 4D

the awareness of the effects of sediment runoff from urban construction sites. The authors describe the program for sediment control developed in the Washington metropolitan region. The authors suggest that more research needs to be done on this problem and explain that the cost of protecting denuded surfaces at construction sites in high-cost land areas 'appears to be within reason.' (Holmes-Rutgers) W71-08821

EROSION AND SEDIMENTATION FOLLOW-ING ROAD CONSTRUCTION AND TIMBER HARVEST ON UNSTABLE SOILS IN THREE SMALL WESTERN OREGON WATERSHEDS, Pacific Northwest Forest and Range Experiment Station, Corvallis, Oreg.

R. L. Fredriksen.

USDA Forest Serv Res Pap PNW-104, 15 p.

Descriptors: \*Clearcutting, \*Road construction, \*Sedimentation rates, Sediment yield, Bed Load, Suspended load, Soil stability, Soil erosion, Landslides, Oregon, Pacific Northwest US. Identifiers: \*Experimental watersheds, Humid tem-

perature climate, Forest roads.

In two steep headwater drainages, landslides were the predominant source of increased sedimentation of streams following timber harvest. Patch-cut logging with forest roads increased sedimentation compared with a control by more than 100 times over a 9-year period. Landslide erosion was greatest where roads crossed high gradient stream channels. In an adjacent clearcut watershed with no roads, sedimentation increased three times that of the control. W71-08851

TERRAIN AND COVER EFFECTS ON SNOW-MELT IN A WESTERN WHITE PINE FOREST, Intermountain Forest and Range Exp Station,

Logan, Utah. P. E. Packer.

Forest Science, Vol 17, No 1, p 125-134, Mar

Descriptors: \*Ablation, \*Snowmelt, \*Canopy, \*Elevation, \*Slopes, \*Clearcutting, Forest management, Snow management, White pine trees, Solar radiation, Idaho.

Identifiers: \*Terain, \*Aspect, Basal area, Cumulative diameter.

Whether increases in snowpack water that result from cutting timber in western white pine (Pinus monticola Dougl.) forests of the northern Rocky Mountains can create flood-producing conditions depends, in part, upon the melting behavior of the snowpack under various terrain and forest conditions. Reported are results of a 4-year study which show that snowmelt (ablation) rates are influenced significantly by differences in terrain and forest cover conditions. Differences in elevation, aspect, slope steepness, and forest cover accounted for 74 percent of the variance in snowmelt rate. Forest managers can exert some control over snowmelt rates by choosing the terrain and forest cover con-ditions suitable for specific forest management practices. Clearcutting of the most dense forest stands on southerly aspects at low to intermediate elevations provides largest increases in snowmelt rates. Partial cutting of timber on northerly aspects at intermediate to high elevations affords the best opportunity to effect reductions in snowmelt rates. (Packer-USFS) (Packer-US) W71-08854

#### 4D. Watershed Protection

EFFECT OF LAND USE ON THE HYDROLOGY OF SMALL WATERSHEDS IN SOUTHWESTERN WISCONSIN, North Central Forest Experiment Station, La

Crosse, Wis.

For primary bibliographic entry see Field 04A.

W71-08839

IMPROVING SURVIVAL OF ALKALI SACATON SEEDLINGS UNDER ADVERSE

CONDITIONS,
Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

For primary bibliographic entry see Field 021. W71-08850

EROSION AND SEDIMENTATION FOLLOW-ING ROAD CONSTRUCTION AND TIMBER HARVEST ON UNSTABLE SOILS IN THREE SMALL WESTERN OREGON WATERSHEDS, Pacific Northwest Forest and Range Experiment Station, Corvallis, Oreg.
For primary bibliographic entry see Field 04C. W71-08851

**FERTILIZERS** FOR BULLET-PLANTED LOBLOLLY PINES,

Southern Forest Experiment Station, Oxford, Miss. Paul D. Duffy

Mississippi Farm Research, Vol 33, No 7, p 1, 5, July 1970.

Descriptors: \*Fertilization, \*Loblolly pine trees, \*Nutrient requirements, Growth rates, Root development, Nitrogen, Phosphorus, Potassium, Erosion control, Reforestation, Mississippi. Identifiers: \*Containerized planting, \*Tree planting, \*Forest fertilization, Afforestation.

A solution containing nitrogen, phosphorus, and potassium applied to soil around 9-week-old loblolly pines in plastic bullet-shaped containers significantly increased top and root growth during the first 9 weeks after a simulated outplanting. These increases in initial growth should aid establishment of container plantings being tested as means to establish erosion control plantings. W71-08855

#### EROSION ON INTERMOUNTAIN SUMMER RANGES,

Intermountain Forest and Range Experiment Station, Ogden, Utah. Richard O. Meeuwig. USDA Forest Serv Res Pap INT-85. 25 p.

Descriptors: \*Sheet erosion, \*Vegetation effects, \*Soil properties, Simulated rainfall, Soil texture, Organic matter, Wettability, Range management, Slope stability, Soil stability, Soil density, Soil aggregates, Soil moisture, Impact (Rainfall), Estimating equations, Utah. Identifiers: \*Slope gradient.

Simulated rain was applied to small plots on seven mountain range land sites in Utah, Idaho, and Montana. Multiple regression equations were developed for each site relating the resultant erosion to cover characteristics, soil properties, and slope gradient. The magnitude of erosion was found to depend primarily on the proportion of the soil surface proprimarily on the proportion of the soil surface pro-tected from direct raindrop impact by plants, litter, and—in some cases—stone. Soil organic matter favored stability of fine-textured soils, but ap-parently increased erodibility of sandy soils. The regression equations are presented in tabular and nomographic form to aid the land manager in the assessment of potential sheet erosion on sites similar to those studied. W71-08856

WEEPING LOVEGRASS FOR VEGETATING STRIP-MINE SPOILS IN APPALACHIA,

Northeastern Forest Experiment Station, Berea,

For primary bibliographic entry see Field 05G. W71-08857

SITE REHABILITATION UNDER PLANTED REDCEDAR AND PINE. Southern Forest Experiment Station, Oxford, Miss.

In: Tree Growth and Forest Soils, p 339-345, 1970. Proc, Third North American Forest Soils Conf, 1968, Raleigh, NC.

Descriptors: \*Erosion control, \*Land reclamation, \*Infiltration, Soil physics, Soil chemistry, Soil chemical properties, Soil analysis, Vegetation effects, Humus, Porosity, Mississippi.

Identifiers: \*Site rehabilitation, Liter accumulation, Water transmission rates, Mississippi.

The study compares long-term changes in the physical and chemical properties of soil and litter on croded old fields planted to pure stands of redcedar, loblolly pine, shortleaf pine, and mixtures of redcedar with loblolly and redcedar with shortleaf to determine which species or species combination rehabilitated the site most rapidly. combination rehabilitated the site most rapidly. Litter accumulation under pure stands of pine was more than twice as deep and three to four times as heavy as that under pure redeedar. Water transmission was three to five times faster under the pure pines than under the pure redeedar. Under shortleaf, the litter contained more nitrogen and calcium and the soil contained more organic matter than under loblolly pine. However, loblolly produced more litter than did shortleaf and water transmission was more rapid beneath it. Thus, of the two sion was more rapid beneath it. Thus, of the two pines, loblolly appears to be superior for site protection and rehabilitation.
W71-08859

## FOREST FLOOR CHARACTERISTICS IN SOUTHWESTERN WISCONSIN, North Central Forest Experiment Station, St. Paul,

M. Dean Knighton. USDA Forest Serv Res Note NC-102. 2 p.

Descriptors: \*Humus, \*Soil compaction, Grazing, Descriptors: "Humus, \*Soil compaction, Grazing, Soil surfaces, Watershed management, Soil properties, Soil formation, Soil crosion, Land reclamation, Pasture management, Wisconsin. Identifiers: \*Humus variability, \*Humus development, Coulce Experimental Forest.

Percent slope, aspect, topographic position, and crown closure were found to have no significant influence on forest floor depth in southwestern Wisconsin. However, a significant decrease in forest floor depth from 8.5 to 6.7 cm. and an increase in soil compaction were found on currently grazed slopes. Yet when grazing is stoped recovery is apparently quick with no permanent damage. W71-08860

#### CONTAINERIZED PINES FOR ERODED WATERSHEDS.

Southern Forest Experiment Station, Oxford, Miss. D. C. McClurkin.

Journal of Soil and Water Conservation, Vol 26, No 1, p 25-26, 1971.

Descriptors: \*Forest management, \*Reforestation, Erosion control, Pine trees, Plastics, Soil stabiliza-tion, Slope stabilization, Fertilization, Reclama-

tion, Germination, Mississippi.
Identifiers: Containerized lanting, Polypropylene tubing, Peat pellets, Polystyrene bullets, Seedling survival, Eroded watersheds, Planting practices.

Containerized planting appears feasible for revegetating eroded sites and extending the current planting season into the summer. In a designed study of polypropylene tubing, peat pellets, polystyrene 'bullets,' seedlings outplanted in pellets consistently survived better than those in tubes or bullets; tubes and bullets were about equally effective. The superior performance of seedlings in pellets may be due more to the fertilizer added to pellets during their manufacture than to the container. Addition of fertilizers to soil in bullets produced dramatic increases in seedling height growth and root development in a greenhouse study. If techniques such as fertilization of the potting soil can consistently improve field survival and growth

#### Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

#### **Group 4D—Watershed Protection**

and if planting devices can be installed on light vehicles designed for difficult terrain, containerized planting should make rehabilitation of southern watersheds far easier.

W71-08861

EVALUATING WATERSHED MANAGEMENT ALTERNATIVES,

Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

ASCE Proceedings, Journal of the Irrigation and Drainage Division, Vol 97, No IR-1, Paper 7952, p 93-108, Mar 1971. 16 p, 7 fig, 6 tab, 20 ref.

Descriptors: \*Watershed management, \*Water resources development, \*Reviews, \*Arizona, Proresources development, 'Reviews, 'Alizona, 'Ro-jects, Evaluation, Irrigation, Surface waters, Water yield, Vegetation effects, Sedimentation, Erosion control, Forestry, Wildlife, Clear-cutting, Runoff, Agriculture, Cattle. Identifiers: \*Beaver Creek (Ariz).

On the Beaver Creek Pilot Project in Arizona evaluations are made of watershed management designed to increase water yield. There have been modest gains in cattle forage following cabling Utah juniper and felling alligator juniper, but these are offset by complete loss of wood production.
Water and sediment yields are unchanged, and wildlife effects are uncertain. There were substantial gains in water production and forage for cattle and wildlife following clear-cutting ponderosa pine, but there were large losses in terms of wood, aesthetics, and sedimentation. A more refined pine treatment, where one-third of a watershed was cleared in 60foot strips, has been completed for 1 yr. There are indications of increased water, herbage, and wildlife yields from this treatment. Losses in the other values have been less than with clearcutting. (Woodard-USGS) W71-08915

#### 05. WATER QUALITY **MANAGEMENT AND PROTECTION**

#### 5A. Identification of Pollutants

WATER RESOURCES DATA FOR COLORADO, 1969: PART 2. WATER QUALITY RECORDS.

Geological Survey, Denver, Colo. For primary bibliographic entry see Field 07C. W71-08324

MERCURY IN THE ENVIRONMENT--SURFI-CIAL MATERIALS OF THE CONTERMINOUS

UNITED STATES,
Geological Survey, Washington, D.C.
Hansford T. Shacklette, Josephine G. Boerngen, and Robert L. Turner.

Free on application to the US Geological Survey, Washington, DC, 20242. Geological Survey Circular 644, 1971. 5 p, 1 fig, 1 tab, 10 ref.

Descriptors: \*Pollutants, \*Heavy metals, \*Soil chemical properties, \*Environmental effects, \*United States, Ecology, Earth materials, Environ-ment, Soils, Chemical analysis, Sampling, Data collections, Distribution patterns, Path of pollutants,

Histograms. Identifiers: \*Mercury, \*Mercury pollution.

Mercury determinations for 912 samples of soils and other regoliths from sites approximately 50 miles apart throughout the United States are represented on a map by symbols showing five ranges of concentration. A histogram of mercury concentrations in the samples is also given. The geometric mean concentration of mercury is 71 parts per billion for all samples, 96 ppb for samples from the Eastern United States, and 55 ppb for samples from Western United States. Twelve samples contained at least 1,000 ppb mercury; the greatest concentration found was 4,600 ppb. (Woodard-USGS) W71-08326

#### DETECTION OF OIL SLICK POLLUTION ON WATER SURFACES WITH MICROWAVE RADIOMETER SYSTEMS,

Microwave Sensor Systems, Inc., Downey, Calif.; and California Univ., Santa Barbara.
J. C. Aukland, W. H. Conway, and N. K. Sanders.
Proceedings 6th International Symposium on Remote Sensing of Environment, Michigan University, Ann Arbor, Oct 13-16, 1969, Vol 2, p 789-796, 1970. 8 p, 5 fig, 5 ref.

Descriptors: \*Pollutant identification, \*Water pollution sources, \*Oil-water interfaces, \*Remote sensing, \*Microwaves, Oceanography, Radio waves, Aircraft, Water temperature, Surface waters, Radiation, Tracking.

Identifiers: \*Oil slick tracking, \*Microwave radiometry.

Two mechanisms by which the presence of oil on a water surface may be detected are discussed. Both of these mechanisms create an apparent temperature anomaly when oil is present. It is the presence of this local anomaly in the relatively uniform background of the sea surface that will signify the detection of oil pollution. An analytical basis for the mechanisms was developed, and the results of the experimental verification are presented. The first phenomena is concerned with measuring the local change in sea state due to the presence of the oil pollution. This phenomena presents very strong signals to microwave radiometers when winds of 6 knots or more are blowing. This is a primary detection mechanism for thin oil films. The second mechanism is the direct change in the emissivity of the water surface due to the presence of oil. This phenomena is slightly the weaker of the two, but of-fers the promise of measuring oil thickness. Because of the independence of these two potential detection mechanisms they are described separately. (Woodard-USGS) W71-08361

#### MULTISPECTRAL SENSING OF OIL POLLU-TION,

Michigan Univ., Ann Arbor.
D. S. Lowe, and P. G. Hasell.
Proceedings 6th International Symposium on Remote Sensing of Environment, Michigan University, Ann Arbor, Oct 13-16, 1969, Vol 2, p 755-765, 1970. 11 p, 6 fig, 2 ref.

Descriptors: \*Oily water, \*Oceans, \*Water pollution sources, \*Tracking techniques, \*Remote sensing, Aircraft, Photography, Pacific Ocean, sensing, Aircraft, Photography, Pacific Ocean, Methodology, Surface waters. Identifiers: \*Oil spill, \*Oil slick, Santa Barbara

(Calif).

The Santa Barbara oil spill of 1969 offered an excellent opportunity to observe and map large scale oil pollution in a natural setting. The University of Michigan conducted multispectral flights over the slick in early March. Imagery made from selected spectral bands extending from the ultraviolet through the thermal infrared are presented. Imagery from an early morning flight shows the slick best contrasted in the UV and thermal infrared and not detectable in the photo-infrared. (Woodard-USGS) W71-08363

#### CHEMICAL CHARACTERISTICS OF OR-GANIC COLOR IN WATER,

Washington, Univ., Seattle, Dept. of Civil Engincering.

Russell F. Cristman, Masahisa Nakamura, and Warren Williams.

Available from the National Technical Information Service as PB-199 707, \$3.00 in paper copy, \$0.95 in microfiche. Final Report 16020DKW 09/70, 93 p, 42 fig, 15 ref. FWQA Grant No WP-EF-01031. Descriptors: \*Color, \*Computer programs, Least squares method, Mathematical model, Data processing, Sampling, Solubility, Adsorption, Hydrogen ion concentration, Volumetric analysis, Colorimetry, Colloids, Coagulation, Chemical precipitation

Identifiers: Electrical charge, Jar tests, Graphs, Transmission, Total organic carbon, Hydrogen ion concentration meter.

The colloid charge titration technique described by The colloid charge titration technique described by Kawamura and Tanaka, was used to measure the charge on color-aluminum, color-thorium, and color-lanthanum dispersions. This method was able to measure the charge on colloids which were too small to be seen, thus replacing the Briggs microelectrophoresis cell technique. Tests were conducted using a Lumetron Model 402E filter photometer to obtain data points of pH vs % transmission; and nH vs total organic carbon. A comphotometer to obtain data points of pri vs. transmission; and pH vs total organic carbon. A computer program was designed to perform a least squares analysis on all the data points to determine the shape of the curve, and the curves were then plotted on a plotter. The program which was developed will analyze as many as 15 sets of data. Analyses made on data taken from actual colored influent will provide operators with plots which show the optimum operating conditions for a particular color removal problem. (Lowry-Texas) W71-08396

WATER QUALITY STUDY OF THE POPLAR RIVER, DOUGLAS COUNTY, WISCONSIN - TRIBUTARY TO LAKE SUPERIOR, Wisconsin State Univ., Superior. Dept. of Chemistry; and Wisconsin Univ., Madison. Water Resources Center. Resources Center. For primary bibliographic entry see Field 05B. W71-08495

DISTRIBUTION OF SELECTED METALS IN BOTTOM SEDIMENTS, Illinois Univ., Urbana. Water Resources Center. For primary bibliographic entry see Field 05B. W71-08497

#### ROLE OF MICROORGANISMS GROWING ON OIL IN THE SELF-CLEANING AND INDICA-TION OF OIL POLLUTION IN THE SEA, O. G. Mironov.

Available from the National Technical Information Service as JPRS 52491, \$3.00 in paper copy, \$0.95 in microfiche. Translated from: Okeanologiya, Vol 10, No 5, p 820-827, 1970, JPRS-52491, Feb 1971. 12 p, 3 fig, 17 ref.

Descriptors: \*Oil, \*Oil wastes, Oily water, \*Indica-

tors, \*Water pollution sources.
Identifiers: \*Biodeterioration, Oxidation, Black Sea, Indian Ocean, Marine microorganisms, Hydrocarbons, Peptones, USSR, Translations.

The microorganisms isolated from the water of the Black Sea and Indian Ocean can grow on oil and oil products, using them as the only source of carbon and energy. This fact suggests a possible oxidation of oil products that occur in the sea. However, the vast majority of hydrocarbon-oxidizing microorganisms show an ability to grow not only on hydrocarbons but also on other carbon sources, e.g. on peptones. Therefore, when hydrocarbon and non-hydrocarbon sources of carbon, specifically oil and sewage, co-occur in the sea, the self-cleaning of organic sewage components from the sea area will be more rapid than the rate of oil decomposition in the sea water. A close correlation between the presence of hydrocarbon-oxidizing microorganisms and oil pollution of sea water provides a logical basis for regarding the group of bacteria as an oil pollution indicator. W71-08503

#### MERCURY ANALYSES AND TOXICITY: A

Teledyne Brown Engineering, Huntsville, Ala. Environmental Sciences; and Carnegie-Mellon Univ., Pittsburgh, Pa.

#### WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

#### Identification of Pollutants—Group 5A

For primary bibliographic entry see Field 05C. W71-08517

#### NATIONAL SYMPOSIUM ON DATA AND INSTRUMENTATION FOR WATER QUALITY MANAGEMENT.

Kerrigan, James E., Editor. Available from Water Resources Center, Hydraulics and Sanitary Lab, Univ of Wisconsin, Madison, Wis, 53706, Price \$5.00. Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, 1970. 521 p. OWRR Project A-999-WIS (13).

Descriptors: \*Data processing, \*Data collections, \*Data storage and retrieval, \*Water quality control, \*Conferences, Water pollution control, Monitoring, Hydrologic data, Flood forecasting, Digital computers, Systems analysis, Simulation analysis, Computer programs.
Identifiers: \*Water quality data.

The National Symposium on Data and Instrumentation for Water Quality Management was held at the University of Wisconsin in Madison, Wisconsin, on July 21-23, 1970, under the joint sponsorship of the Conference of State Sanitary Engineers and the Wisconsin Water Resources Center, with sixteen professional societies as cosponsors. The central theme of the 43 papers in the Symposium was to assess the benefits offered by advanced data collection, analysis and display systems toward the enhancement of the nation's environment. (See also W71-08551 thru W71-08569) (Knapp-USGS) W71-085550

## WATER QUALITY INFORMATION SYSTEMS, THE KEY TO CLEANER WATERS, Pennsylvania Dept. of Health, Harrisburg. Bureau

of Sanitary Engineering. Walter A. Lyon.

Water A. Lyon.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 2-7, 1970. 6 p.

Descriptors: \*Water quality, \*Monitoring, \*Water pollution control, \*Data collections, \*Data processing, Pennsylvania, Conferences, Reviews, Water resources research act. Identifiers: \*Water quality information systems.

The present state of water quality information systems is poor. The shortest response time between the recognition of pollution problems in a major water body and its solution is between fifteen and twenty years. Adequate forecasting systems should shorten this response time to prevent interim degradation. Most of the nation's waters are polluted because of this long response time. As a result of a research and development grant from result of a research and development grant from the Federal Water Quality Administration, the Pennsylvania Department of Health is in the process of developing a Water Quality Manage-ment information System, designed to show how a state can, to the fullest extent, develop such a system and base its operations on the utilization of such a system. The first year of the grant has just been concluded and two major modules of the comprehensive system, a water quality module and a facilities module have been designed and programmed. (See also W71-08550) (Knapp-USGS) W71-08551

## COORDINATION - THE KEY TO EFFECTIVE WATER DATA MANAGEMENT, Geological Survey, Washington, D.C. Office of Water Data Coordination.

Water Data Coordination.
R. H. Langford, and W. W. Doyel.
Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 8-32, 1970, 25 p, 11 fig.

Descriptors: \*Hydrologic data, \*Data collections, \*Data storage and retrieval, \*Data processing, Management, Planning, Water resources research act, Governments, Federal government, Interagency cooperation, Conferences, Reviews. Identifiers: \*Water data management, Office of Water Data Coordination.

Although there are large quantities of water data being acquired in the United States and large amounts of money being spent on that acquisition and the subsequent handling, the data are not fully and the subsequent handling, the data are not fully utilized, nor are they always acquired at the proper place or at the proper time. The cost of acquiring the data increases as part of the general increase in the cost of doing any type of activity. Therefore, in order to give the data user the date he needs in the format in which he needs them and in the time frame in which he requires them, it is necessary to fully coordinate data acquisition activities. Thus, by lumping needs, preparing a unified acquisition program and entering the resultant data in a data handling system, maximum use can be made of a minimum amount of data. Within the Federal establishment coordination procedures now are being tested. (See also W71-08550) (Knapp-USGS)
W71-08552

## BASIC DATA REQUIREMENTS TO EVALUATE WATER POLLUTION IN QUALITY CONTROL PROGRAMS,

NUS Corp., Pittsburgh, Pa. Cyrus William Rice

Paul V. Morgan.

Paul V. Morgan.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 33-56, 1970. 24 p, 6 tab, 4 ref.

Descriptors: \*Monitoring, \*Water pollution control, \*Reviews, \*Water quality, \*Water Quality Act, Instrumentation, Programs, Governments, Data collections, Hydrologic data, Management, Planning, Federal government, Inter-agency cooperation, Conferences. Identifiers: \*Water quality data.

The effective conduct of a national pollution control program requires that reliable information on water quality be collected, analyzed, and evaluated in a timely and efficient manner. The real progress during the last decade has been in the number and variety of applications of automatic water quality variety of applications of automatic water quality monitoring equipment throughout the country by a variety of federal, state, and interstate agencies, and private groups. There are quite a number of industrial plants utilizing monitors in major effluent streams. The Federal Water Pollution Control Act amendments in 1961, the Water Quality Act of 1966. 1965, the Clean Water Restoration Act of 1966, the Water Quality Improvement Act of 1969, the Federal Water Pollution Control Act of 1970 continued the ever-increasing involvement of the federal government in water pollution control which had previously been allocated to the states. See also W71-08550) (Knapp-USGS) W71-08553

#### A SYSTEMS APPROACH TO WATER QUALI-TY DATA MANAGEMENT,

Price Waterhouse and Co., Philadelphia, Pa. Management Advisory Services.

George B. Murdock.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 57-75, 1970. 19 p, 7 ref.

Descriptors: \*Systems analysis, \*Monitoring, \*Water pollution control, \*Reviews, \*Water quali-Descriptors: ty, \*Water quality act, Instrumentation, Programs, Governments, Data collections, Hydrologic data, Management, Planning, Federal government, Interagency cooperation, Conferences.
Identifiers: \*Water quality data.

Review of the literature reveals that pollution control and other environmental quality problems are complex enough to be examined by means of the systems approach. The insights gained may lead to better solutions. With the advent of modern systems techniques, increasing interest in them has been shown by federal, state, and local govern-ments and other decision making bodies. A water ments and other decision making bodies. A water quality management information system will greatly enhance the speed and precision with which decisions may be made in the water quality management field, and thereby increase the effectiveness of the program as a whole. The Commonwealth of Pennsylvania is developing new water quality management techniques by applying modern systems concepts to a state program. This project has been supported and financed, in part, by the Federal Water Quality Administration, Department of the Interior, pursuant to the Federal Water Pollution Control Act. It is intended that this project will develop uniform systems techniques project will develop uniform systems techniques applicable to other states' water pollution control programs. (See also W71-08550) (Knapp-USGS) W71-08554

#### LESSONS TO BE LEARNED WHEN COLLECT-ING VALID DATA,

Manhattan Coll., Bronx, N.Y. Dept. of Civil En-

Robert V. Thomann.
Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 76-86, 1970. 11 p, 5 fig, 1 ref.

Descriptors: \*Data collections, \*Hydrologic data, \*Water quality, Monitoring, Model studies, Water pollution control, Reviews, Conferences, Mathematical models, Systems analysis. Identifiers: \*Water quality data.

The validity of data involves the uses that are made of the information that is collected for water qualiof the mormaton that is confected for water quali-ty studies. In addition, the validity of data is deter-mined by (1) conditions of sampling, (2) accuracy of the measurement of the sample, and (3) the time-space variability of the systems that are being sampled. The uses to which data are being put must be analyzed carefully so that a meaningful sample collection program can be devised. Cognizance must be taken of the expected response times of systems, the order of magnitude of the response times, and load and water quality variability, all of which determine the space and time details of the sample collection program. (See also W71-08550) (Knapp-USGS) W71-08555

## EXPERIENCES WITH AUTOMATION IN REMOTE SAMPLING AND ANALYSIS OF SURFACE WATERS,

American Chain and Cable Co., Glen Cove, N.Y. Bristol Datamaster Div.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 87-98, 1970. 12 p, 4 fig.

Descriptors: \*Telemetry, \*Monitoring, \*Water quality, \*Water pollution control, \*Illinois, Reviews, Conferences, Sampling, Data collections, Hydrologic data, Canals, Sewage treatment, Storm

Identifiers: \*Chicago (III), \*Water quality data.

The Chicago Sanitary District covers 850 square miles and provides water and sewage facilities for a population of 5.5 million plus an industrial load equivalent to an additional 3 million people. It maintains 71 miles of inland water ways. The plan uses an installed and fully operational integrated Data Acquisition System to monitor water quality of the water ways and point the way to the most efficient methods of the pollution abatement. The system consists of eleven monitoring stations, three

#### Group 5A-Identification of Pollutants

secondary receiving stations, and one central receiving station. Each monitoring station telemeters its sampling data to one secondary station and to the central station. The secondary stations are located at each of the major sewage treatment works which discharge effluent to the water ways. Because of the location of the monitoring stations, each treatment plant knows the quality of water entering the system, the condition of the effluent discharges, and the quality of the water leaving its system. (See also W71-08550) (Knapp-USGS) W71-08556

FORECASTING OF WATER QUALITY DATA IN THE DELAWARE RIVER ESTUARY, Delaware River Basin Commission, Trenton, N.J.

Peter K. MacEwen, and Richard C. Tortoriello.
Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 99-123, 1970. 25 p, 19 fig, 1 tab, 5 ref.

Descriptors: \*Mathematical models, \*Delaware River, \*Delaware River Basin Commission, \*Monitoring, \*Dissolved oxygen, Reviews, Conferences, Streamflow, Sewage, Water quality, Water pollu-tion control, Data collections, Hydrologic data,

Sampling. Identifiers: \*Water quality data.

A mathematical model of both steady-state and the time-varying water quality was developed for the Delaware Estuary. The model demonstrates the cause-and-effect relationship between oxygen demanding waste material, both carbonaceous and nitrogenous, and the resulting DO level in the Estuary. The water quality models are realistic predictors of both dissolved oxygen and salinity for years 1964 and 1968, under different conditions of waste loading and stream flows. In establishing water quality effluent standards for industries and municipalities, the steady-state model was used to determine the cause-effect relationship between stream DO and the waste load discharged to the Estuary. Use of such a model permitted the investigation of various alternatives of waste treatment in the Estuary and the resulting effects on the river. (See also W71-08550) (Knapp-USGS) W71-08557

#### NEED FOR WATER QUALITY DATA IN PLANNING WATER RESOURCE DEVELOP-MENTS,

Geological Survey, Lincoln, Nebr. Water Resources Div. Lester R. Petri

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Manage-ment, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 125-129, 1970. 5 p.

Descriptors: \*Data collections, \*Data processing, \*Hydrologic data, \*Water quality, Monitoring, Water resources development, Planning, Reviews, Conferences, Analytical techniques, Statistical

Identifiers: \*Water quality data.

Water quality data needed in planning may be separated into two categories: (1) basic data, and (2) interpretive data. Basic data are those obtained by direct measurement of the resource itself or of the environment in which the resource is found. Interpretive data are those derived by analysis of basic data. They may be statistical indices such as means, modes, or coefficients of correlation. A program must consider the fact that important changes in water quality sometimes take place gradually and cannot easily be detected with shortterm records. Also, the proper range of conditions to be sampled cannot be depended upon to occur in any given year. Therefore, operation of the program must be on a continuing basis so that data representing long-term conditions will be available when they are needed. A carefully designed pro-

gram identifies the kinds of measurements most likely to be needed and provides for their collection. Provisions in the program must be made to review periodically the data being collected for its intrinsic value. (See also W71-08550) (Knapp-W71-08558

#### DATA NEEDS IN ENGINEERING DESIGN, Datagraphics, Allision Park, Pa.

Henry C. Bramer.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 130-136, 1970. 7 p.

Descriptors: \*Data collections, \*Hydrologic data, \*Planning, \*Monitoring, \*Water pollution control, Costs, Water quality, Abatement, Water quality control, Water quality act. Identifiers: \*Water quality data.

This review of data needs is directed to those specifically usable for engineering design purposes, on the basis that facilities are constructed to maintain specified water quality levels required by the uses to be made of receiving streams, and that such objectives are to be realized in the most generally cost-effective means possible. The total engineering effort includes the engineering input of the regulatory agencies as well as that of the design engineer. As mathematical modeling techniques applicable to the prediction of water quality in stream, to process design, and to cost estimation become more sophisticated, the practical uses of water quality information will increase. These techniques allow the engineer to comprehensively weigh alternatives so as to define the most cost effective. (See also W71-08550) (Knapp-USGS) W71-08559

## NEED FOR WATER QUALITY DATA IN OPERATING WATER IMPOUNDMENTS, Bureau of Reclamation, Washington, D.C. Div. of

Water and Land Operations.

Maurice N. Langley.
Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 137-144, 1970. 8 p.

Descriptors: \*Water quality control, \*Reservoir operation, \*Data collections, \*Monitoring, Water utilization, Reservoir stages, Lake morphometry, Hydrologic data, Water storage, Water pollution

Identifiers: \*Water quality data.

The need for water quality data in operating water impoundments is governed largely by the characteristics of the inflows; the location, size, depth, and configuration of the impoundment; the activities of man on the water and shorelines; the direct multiple uses of the impoundment; and the downstream purposes for which the water is to be used. A regular monitoring program of input, in storage, and downstream water quality charac-teristics, coupled with knowledge of the effects of water quality on the multiple purposes that an impoundment is to serve, can assist greatly in maximizing benefits. Such data will serve to point up at an early stage the development of undesirable reservoir characteristics. (See also W71-08550) (Knapp-USGS) W71-08560

#### PYROGRAPHIC GROSS CHARACTERIZATION AND MONITORING OF WATER POLLU-TANTS.

Rocketdyne, Athens, Ga. Southeast Field Lab. Ihor Lysyj.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 145-159, 1970. 15 p, 4 fig, 6 ref. FWQA Contract No 14-12-802.

Descriptors: \*Water analysis, \*Monitoring, \*Water pollution control, \*Data collections, \*Analytical techniques, Gas chromatography, Pollutant identification, Data processing, Computers Computers. Identifiers: \*Pyrolysis.

A design of a prototype instrumental system for the performance of pyrographic water-quality analysis and the development of procedures for the inter-face of instrumental hardware and computer software for a fully integrated and automatic sequence of chemical analysis, data acquisition, data reducor chemical analysis, data acquisition, data reduc-tion and the computation of results are discussed. Using this technique it is possible to determine the degree of pollution in a given waterway quantita-tively and to determine the relative contributions of tively and to determine the relative contributions of each waste discharging source to the total pollution load of the river. The pyrographic analysis of a downstream sample permits calculation of the total pollution load of the river at that point, and the calculation of the percent contributions of various dischargers to such a pollution load. (See also W71-08550) (Knapp-USGS)

## APPLICATION OF REMOTE SENSING TO WATER QUALITY MANAGEMENT,

Ecology and Environment, Inc., West Seneca, N.

G. Strobel, and F. Silvestro.
Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis., p 160-165, 1970. 6 p, 1 fig, 4 ref.

Descriptors: \*Remote sensing, \*Monitoring, \*Water quality, \*Data collections, \*Water pollution control, Solar radiation, Aerial photography, Photometry, Spectroscopy. Identifiers: \*Water quality data.

Due to the size of the bodies of water and the wide distribution of waste outfalls that must be monitored, an approach utilizing quantitative remote sensing technology including spectral photography and visible and infrared scan systems will allow efficient gathering of the required data. Basically, these systems optically gather sunlight that is scat-tered or reflected by the pollutant. Spectral photographic techniques allow categorizations of water quality including estimates of algae concentration.
Suspended solids concentration of a water course can be quantified to about 1 ppm. The source of the discharge is grossly classified using the spectral reflectance curve. (See also W71-08550) (Knapp-USGS) W71-08562

#### FUNDAMENTALS OF SYSTEMS DESIGN.

Geological Survey, Washington, D.C. Charles R. Showen.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 177-182, 1970. 6 p, 5 ref.

Descriptors: \*Data collections, \*Data processing, Descriptors: "Data concertions, "Data processing, \*Data transmission, \*Hydrologic data, \*Networks, Telemetry, Statistics, Monitoring, Water quality, Water quality control. Identifiers: \*Water quality data, \*Data systems

design.

System design has a vital role in the establishment of an efficient data handling system. Careful analysis, inventiveness, and ingenuity by the design team have a definite impact on the effectiveness of the system. The complexity of the system is dependent upon the user demands of the system. The time required to design and implement a small system

can be only a few months, while the time required to design an elaborate system can take many months or several years. As systems become larger and more interrelated, users will need standardization to ease communication and formatting problems so that transfer of data between the systems is more easily achieved. (See also W71-08550) (Knapp-USGS)
W71-08564

#### ORGANIZING A DATA COLLECTION PRO-

GRAM, Bureau of Reclamation, Sacramento, Calif. W. Martin Roche.

W. Martin Roche.
Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Maidson, Wis, p 183-191, 1970. 9 p, 1 fig.

Descriptors: \*Data collections, \*Data processing, \*Data transmission, \*Hydrologic data, \*Networks, Telemetry, Statistics, Monitoring, Water quality, Water quality control.

Identifiers: \*Water quality data, \*Data systems

In California, several state and federal agencies work together in organizing a water quality data collection program. By using a coordinated approach and by maintaining contact throughout the program, men and equipment can be efficiently used, duplicated efforts can be avoided, costs can be minimized, and accurate, consistent data can be obtained. The U. S. Bureau of Reclamation's Water Quality Surveillance Program in the San Francisco Bay-Delta Estuary is an excellent example of a cooperative study. The Delta plays a key role in the Burcau's Central Valley Project and in California's State Water Project, as it serves as the collection and export point for water stored in reservooirs in northern California. Water is released from storage and is pumped from the Delta channels to be sent via canals to agricultural lands in the semiarid San Joaquin Valley. Data collection for the program is carried out under the supervision of the Bureau Correlations of results using different methods of analysis are made so that the results can be placed on a common basis. (See also W71-08550) (Knapp-USGS) W71-08565

## COMPATIBILITY OF SYSTEMS AND IN-TERCHANGE OF DATA, Geological Survey, Washington, D.C. Water

Resources Div.

Melvin D. Edwards.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 192-197, 1970. 6 p.

Descriptors: \*Computer programs, \*Data storage and retrieval, \*Data processing, \*Data collections, \*Hydrologic data, Water quality, Digital compu-ters, Telemetry, Statistics, Networks, Planning,

Identifiers: \*Water quality data, \*U. S. Geological

A common exchange of ideas and techniques between users in the analysis and design of new water quality data systems can contribute much toward increased compatibility between systems.

The U. S. Geological Survey's Water Resources
Division has greatly increased the compatibility of its software systems by implementing procedures for the bilingual interfacing of computer languages. For example, a computer procedure written in the FORTRAN IV language can now be used as a subroutine within a procedure written in the PL/1 language. This has allowed the Division to greatly extend its use of existing internal and external procedures with only a minimal amount of modification to the original source. The Water Resources Division now has the advantage of using existing,

large-scale and standardized statistical packages and processing procedures available in the computer library of the U. S. Geological Survey for the analysis and meaningful reduction of its data. (See also W71-08550) (Knapp-USGS) W71-08566

### EXPERIENCES WITH A WATER POLLUTION CONTROL STORAGE AND RETRIEVAL SYSTEM (STORET), Federal Water Quality Administration, Washing-

ton, D. C. Pollution Surveillance Branch.

Phillip L. Taylor. Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 198-207, 1970. 10 p, 7 fig.

Descriptors: \*Computer programs, \*Data storage and retrieval, \*Data processing, \*Data collections, \*Hydrologic data, Water quality, Digital compu-ters, Telemetry, Statistics, Networks, Planning, Identifiers: \*Water quality data, \*STORET system.

Water pollution control data related to the nation's 3,500,000 miles of flowing streams, over 12,000 miles of general coastline and more than 65,000 square miles of inland open waters are extensive in amounts and varieties. Computers are capable of accepting vast amounts and varieties of data with similar ability to feed back selected information. The Federal Water Quality Administration's STORET System is used primarily for the handling of water quality data. The addition of a variety of remote teleprocessing devices, digitization, and digital plotting applications to the system, and the use of microfilm, all together, represent an extensive system application. With use of remote ter-

minals, particularly low speed types, both digital and CRT, field personnel at any location can have access to data and other information to meet dayto-day needs, thus facilitating the operation of a responsive water pollution control program. (See also W71-08550) (Knapp-USGS)

#### RETRIEVAL OF GROUNDWATER DATA, Geological Survey, Washington, D. C. Water Resources Div. STORAGE AND

L. G. Moore.

W71-08567

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers, and Wisconsin University, July 21-23, 1970, Madison, Wis, p 208-213, 1970. 6 p.

Descriptors: \*Computer programs, \*Data storage and retrieval, \*Data processing, \*Data collections, \*Hydrologic data, Water quality, Digital computers, Telemetry, Statistics, Networks, Planning,

Identifiers: \*Water quality data, \*U. S. Geological

The Water Resources Division of the U.S. Geological Survey has been utilizing the present punch card system for the storage and retrieval of groundwater data for the past six years. Further automation of the Division's historical file was accomplished by the creation of a central data file. To gain greater efficiency in handling the data, the system was divided into three main data bases: well inventory data, quality of water data, and water level data. The well inventory data base describes the geological and hydrologic characteristics and the physical features of the well. The quality of water data base contains the basic chemical analysis and radiochemical data. The water level data base contains descriptive material and the water levels observed in the well. (See also W71-08550) (Knapp-USGS) W71-08568

## A WATER QUALITY STORAGE AND RETRIEVAL SYSTEM FOR REGIONAL APPLI-

CATION,
Texas A and M Univ., College Station.
Roy W. Hann, Jr., and Ted M. Sparr.
Proceedings of the National Symposium on Data
and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and
Wisconsin University, July 21-23, 1970, Madison,
Wis, p 214-222, 1970. 9 p, 2 fig.

Descriptors: \*Computer programs, \*Data storage and retrieval, \*Data processing, \*Data collections, \*Hydrologic data, Water quality, Digital computers, Telemetry, Statistics, Networks, Planning, Reviews.

Identifiers: \*Water quality data, \*U. S. Geological

Data storage and retrieval systems are briefly reviewed. Basically, any scheme for saving data and selectively recalling it later qualified as a storage and retrieval system, whether or not a computer is involved. involved. A computerized data management system may be defined as a set of programs which system may be defined as a set of programs which manages the data base. A list of these management activities commonly includes: data base creation; file maintenance; selective retrieval; and support of high-level file description and retrieval languages used to direct system activities. (See also W71-08569)

#### THE HIGH RESOLUTION NMR SPECTRA OF PESTICIDES, I. ORGANOPHOSPHORUS PESTICIDES, PESTICIDES.

Federal Water Pollution Control Administration, Athens, Ga. Southeast Water Lab. Lawrence H. Keith, Arthur W. Garrison, and Ann

L. Alford.

Journal of the Association of Official Analytical Chemists, Vol 51, No 5, p 1063-1094, Sept 1968. 10 fig, 3 tab, 22 ref. EPA Project No 16020 EWC.

Descriptors: \*Pesticides, \*Nuclear Magnetic Resonance, \*Organophosphorus pesticides, Data Collections, Spectroscopy, \*Pollutant identifica-tion, Analytical techniques.

Identifiers: Chemical shifts, Coupling constants, Spin decoupling.

A description of the 100 MHz nuclear magnetic resonance spectra of 40 organophosphorus pesticides is presented with a list of their chemical shifts and coupling constants. The more complex or unusual spectra are reproduced and discussed. Tables of trends in chemical shifts are reproduced and discussed. Tables of trends in chemical shifts and coupling constants as related to structure are included. (See also W71-08587 thru W71-08590) (Alford-EPA-Southeast Water Laboratory) W71-08586

## THE HIGH RESOLUTION NMR SPECTRA OF PESTICIDES, II. THE DDT-TYPE COM-

POUNDS, Federal Water Pollution Control Administration, Athens, Ga. Southeast Water Lab.
Lawrence H. Keith, Ann L. Alford, and Arthur W.

Journal of the Association of Official Analytical Chemists, Vol 52, No 5, p 1074-1092, Sept 1969. 7 fig, 3 tab, 18 ref. EPA Project No 16020 EWC.

Descriptors: \*Pesticides, \*Nuclear Magnetic Resonance, \*DDT, Data collections, Spectroscopy, \*Pollutant identification, Analytical techniques. Identifiers: Chemical shifts, Coupling constants, Spin decoupling.

The 100 MHz nuclear magnetic resonance spectra of the DDT class of pesticides and related com-pounds are discussed. Various substituents affect the resonances of the aromatic protons. The CCI sub 3 moiety on the alpha-carbon strongly deshields the ortho protons on the aromatic rings, and this deshielding effect is greatly enhanced by

#### Group 5A-Identification of Pollutants

substitution of a chlorine ortho rather than para on the aromatic ring. These deshielding effects are explained by considering the substituent electronegativity and the molecular stereochemistry. Chemical shifts and coupling constants are tabulated. (See also W71-08586 and W71-08588) (Keith-EPA-Southeast Water Laboratory)
W71-08587

THE HIGH RESOLUTION NMR SPECTRA OF PESTICIDES, THE CARBAMATES,

Federal Water Pollution Control Administration, Athens, Ga. Southeast Water Lab. Lawrence H. Keith, and Ann L. Alford. Journal of the Association of Official Analytical Chemists, Vol 53, No 1, p 157-179, Jan 1970. 8 fig, 3 tab, 11 ref. EPA Project No 16020 EWC.

Descriptors: \*Pesticides, \*Nuclear magnetic resonance, \*Carbamate pesticides, \*Thiocarbamate pesticides, Data collections, Spectroscopy, \*Pollutant identification, Analytical techniques Identifiers: Chemical shifts, Coupling constants, Spin decoupling.

The 100 MHz nuclear magnetic resonance spectra of 35 carbamate pesticides and a major metabolite of one pesticide are discussed. Chemical shifts and of one pesticide are discussed. Chemical shifts and coupling constants are tabulated, and reproductions of the more complex or unusual spectra are included. A concentration and solvent dependence of both the NH-proton and the NCH3-proton resonances of an N-monosubstituted carbamate is discussed. Hindered rotation is observed in the N.N-dimethylcarbamates, the thiolcarbamates, and the dithiocarbamates, but not in the N-methylcar-bamates. (See also W71-08586 and W71-08587) (Alford-EPA-Southeast Water Laboratory) W71-08588

#### SUPPLEMENTARY INTERPRETATIONS OF THE NMR SPECTRA OF PHOSPHORUS PESTI-

Federal Water Pollution Administration, Athens,

Ga. Southeast Water Lab.
Lawrence H. Keith, and Ann L. Alford. Analytica Chimica Acta, Vol 44, p 447-448, 1969. 2 ref. EPA Project No 16020 EWC.

Descriptors: \*Pesticides, \*Nuclear Magnetic Resonance, \*Organophosphorus pesticides, Spec-troscopy, \*Pollutant identification, Analytical techniques.

Identifiers: Chemical shifts, Coupling constants,

Spin decoupling.

A brief comparison of the interpretations of the 100-MHz organophosphorus pesticide NMR spectra with the 60-MHz data previously reported by other researchers illustrates the benefits of high resolution and homonuclear decoupling. (See also W71-08586) (Alford-EPA-Southeast Laboratory) W71-08589

REVIEW OF THE APPLICATION OF NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY IN PESTICIDE ANALYSIS,

Federal Water Pollution Control Administration, Athens, Ga. Southeast Water Lab.

Lawrence H. Keith, and Ann L. Alford. Journal of the Association of Official Analytical Chemists, Vol 53, No 5, p 1018-1035, Sept 1970. 1 fig, 47 ref. EPA Project No 16020 EWC.

Descriptors: \*Pesticides, \*Nuclear Magnetic Resonance, Data collection, \*Pollutant identification, Analytical techniques.

Identifiers: Chemical shifts, Coupling constants, Pesticide residue analysis, Pesticide metabolites, Pesticide photolysis.

This review included all references to July 1970, where NMR spectroscopy has been used for structural elucidation of pesticide metabolites and degradation products, for structural confirmation of new pesticides, or for product analysis of existing ones. (See also W71-08586 thru W71-08589) (Alford-EPA-Southeast Water Laboratory)

ACCUMULATION OF DDT RESIDUES IN TRIPHOTURUS MEXICANUS FROM THE GULF OF CALIFORNIA, Stanford Univ., Pacific Grove, Calif. Hopkins

Marine Station.
For primary bibliographic entry see Field 05C.
W71-08601

RECOGNITION OF BUNKER OILS BY THIN-

LAYER CHROMATOGRAPHY, Fisheries Research Board of Canada, Halifax (Nova Scotia).

J. C. Sipos, R. G. Ackman, and R. F. Addison. Fisheries Research Board of Canada, New Series Circular No 37, May 6, 1970. 6 p, 5 fig.

Descriptors: \*Chromatography, \*Oil, \*Analytical techniques, \*Pollutant identification, \*Water analysis, Chemical analysis, Oil water, Oil wastes, Indicators, Tracers, Laboratory tests, On-site data collections, On-site tests.

Identifiers: \*Thin-layer chromatography, \*Oil pollution \*Punkter oil

lution, \*Bunker oil.

Bunker oil contains several groups of 'aromatic' compound carbon skeletons. If these groups could be recognized and proportions estimated, it would be possible to examine oil slicks or beach deposits and compare the oil with samples from suspected ships or other sources, and to examine animal life for bunker oil packup. Compounds of this type, with one or two insignificant exceptions, are not normally found in marine plants or animals. A procedure simple enough for field use is described. (LeGore-Washington) W71-08608

A CONSTANT FLOW DELIVERY DEVICE FOR CHRONIC BIOASSAY,
Colorado State Univ., Fort Collins. Dept. of Fishery and Wildlife Biology.
For primary bibliographic entry see Field 05C.
W71-08618

FALLOUT PROGRAM QUARTERLY SUMMA-RY REPORT (DEC. 1, 1970 TO MARCH 1,

1971), New York Operations Office (AEC), N.Y. Health and Safety Lab.

For primary bibliographic entry see Field 05C. W71-08649

RADIOCARBON IN THE SEA,

Washington Univ., Seattle.
A. C. Fairhill, R. W. Buddenmeier, I. C. Yang, and

A. W. Young. HASL-242, April 1, 1971, p 135-178, 7 fig, 4 tab, 25 ref. AEC Contract No AT (45-1)-2091.

Descriptors: \*Carbon radioisotopes, \*Nuclear explosions, \*Ocean circulation, \*Carbon dioxide, Equilibrium, Atmosphere, Oceans, Geophysics, Vertical migration, Oceanography, Sampling, Radioactivity techniques.

Of the world inventory of natural carbon-14, about 51 metric tons, over 90% is in the oceans. Atmospheric nuclear testing increased the supply about 3%. Some 2/3 of the increase has already been transferred to the oceans, an amount sufficient to increase the carbon-14 of the upper 150 m by 25%. Evidence of bomb carbon-14 was shown in the upper few hundred meters of most ocean areas, to 700 meters in some areas, and to 3600 meters in the North Atlantic. The experimental method included stripping on board ship 60 liter seawater samples of carbon dioxide which were sent to a laboratory for counting. (See also W71-08649) (Bopp-ORNL) W71-08650 CONCENTRATION OF TRACE ELEMENTS IN ENVIRONMENTAL SAMPLES WITH A CENTRIFUGAL CONTRACTOR,

Du Pont de Nemours (E. I,) and Co., Aiken, S. C. Savannah River Lab.

R. C. Milham, and D. W. Hayes, and F. E. Butler. Health Physics, Vol. 20, No. 1, p.91-3, 1971.

Descriptors: \*Zinc radioisotopes, \*Water analysis, \*Radiochemical analysis, Environmental effects, Trace elements, Separation techniques, Neutron activation analysis, Spectroscopy. Identifiers: Extraction.

The centrifugal contractor is suitable for a variety of extraction processes. By contractor modifica-tion, organic extractants with densities greater than water can be used. The contractor can also be used for concentrating trace organic material in suitable solvents. It is also applicable to traces of stable nuclides which are first concentrated and then analyzed by standard analytical methods such as neutron activation, atomic absorption, etc. (Bopp-ORNL)

W71-08651

GAS CHROMATOGRAPHIC ANALYSIS OF TOXAPHENE IN NATURAL WATERS, FISH AND LAKE SEDIMENTS, Wisconsin Univ., Madison. Water Chemistry Lab.

Robert A. Hughes, Gilman D. Veith, and G. Fred

Water Research, Vol 4, p 547-558, 1970. 5 fig, 4 tab, 15 ref.

Descriptors: \*Gas chromatography, \*Analysis, \*Chlorinated hydrocarbon pesticides, Fish, Lakes, Sediments, Wisconsin, Suspended load, Plankton, Colorimetry, Diffusion, Sampling, Chromatography.

Identifiers: \*Cleanup procedures, Toxaphene, Pesticide analysis, Planimetry, Organic inter-ference, Florisil.

The rate of toxaphene, used in Wisconsin for rough fish control, was investigated to determine if water quality parameters could be linked to successful treatment, to evaluate the role of lake sediments in detoxification of toxaphene, and to assess effect of persistent toxaphene residues on restocked fish. The established procedures for removal of chemical interferences from samples for analysis needed modification or supplementary cleanup steps to cope with the organic interferences present in aquatic samples: for example, solids from vegetative sources in water and suspended solids; fats and oils from fish. Special procedures were developed for water, suspended solids, net plankton, fish and sediment. Presence of toxaphene was verified by thin-layer chromatography. Substances which interfered with the electron-capture gas chromatographic quantitation of toxaphene were removed from sample extracts by column chromatography on Florisil, magnesium oxide, alumina and acid-Celite, either alone or in combinations. Since each lake system requires specific procedures to cope with the intereferences present in each body of water, samples were obtained before the toxaphene treatment. Efficiency of procedures depends on quantity and character of organic material present. (Jones-Wisconsin) W71-08681

BIOGEOCHEMISTRY OF A RESERVOIR ECOSYSTEM,

Oklahoma State Univ., Stillwater. Dept. of Chemistry; and Oklahoma State Univ., Stillwater. Dept. of Zoology; and Oklahoma State Univ., Stillwater.

Reservoir Research Center.
Louis P. Varga, Dale W. Toetz, and Troy C. Dorris.
Available from the National Technical Information Service as ORO-2070-3, \$3.00 in paper copy, \$0.95 in microfiche. Oklahoma State Univ, Stillwater, Reservoir Research Center Report No 1, 1970. 13 p, 3 fig, 3 ref.

Descriptors: \*Analytical techniques, \*Reservoirs, \*Nitrate, \*Mathematical models, Computers, Productivity, Instrumentation, Water quality, Monitoring, Digital computers, Analog computers, Data collections.

Identifiers: \*Keystone Reservoir (Okla), \*Continuous data acquisition, Nutrient flux, Nitrate assimilation, Biogeochemistry.

Primary goals are development of instrumentation and techniques for determination of physical and and techniques for determination of physical and chemical properties in natural water systems with emphasis on research that will contribute to improved water quality. 'Second generation' equipment is described, including a schematic diagram of the Keystone Reservoir monitoring system. Analog output from probes is measured by an Orion model 801 digital millivolt meter. Digital output from meter is coupled to a Teletype model PRPE 11 paper tape punch via a Hewlett-Packard output from meter is coupled to a Teletype model PRPE 11 paper tape punch via a Hewlett-Packard model 2545 punch coupling system and special logic translating interface. Field evaluation of a prototype floating sampling station is described. Calibration of ion-selective electrodes and laboratory evaluation is given. Modeling nitrate dynamics indicated uniquely slow rate of nitrate assimilation. (Auen-Wisconsin) (Auen-Wisconsin) W71-08685

THE SANITATION SITUATION OF THE MARINE COASTAL WATERS OF NORTH SARDINIA IN RELATION TO INDUSTRIAL POLLUTION AND URBAN SEWAGE, (SITUAZIONE IGIENCIA DELLE A CQUE MARINE COSTIERE DEL NORD-SARDEGNA IN RAPPORTO ALL' INGUINAMENTO INDUSTRIALE E FOGNARIO-URBANO),
Sassari Univ. (Italy). Instituto di Igiena.
For primary bibliographic entry see Field 05B.
W71-08723

HYGIENIC SITUATION OF SARDINIAN COASTAL WATERS,
Cagliari Univ. (Italy). Instituto di Igiena.
For primary bibliographic entry see Field 05B.

INVESTIGATIONS ON THE STATE OF POLLUTION OF THE COASTAL WATERS OF THE ITALIAN PENINSULA, (ENQUETES SUR L'ETAT DE POLLUTION DES EAUX COTIERES DE LA PENINSULE ITALIENNE), Bologna Univ. (Italy). Instituto Igiena.

For primary bibliographic entry see Field 05B. W71-08725

METHODS FOR SEPARATION OF BDEL-LOVIBRIO FROM MIXED BACTERIAL POPU-LOVIBRIO FROM MIXED BACTERIAL POPULATION BY FILTRATION THROUGH MILLIPORE FILTERS OR BY GRADIENT DIFFERENTIAL CENTRIFUGATION,

Hebrew Univ., Jerusalem (Israel). Dept. of Microbiological Chemistry.

Mazal Varon, and Moshe Shilo.

Mazai varon, and Mosne Shilo.
Revue Internationale d'Oceanographie Medicale,
Centre d'Etudes et de Recherches de Biologie et
d'Oceanographie Medicale, Institut National de la
Sante et de la Recherche Medicale, Foundation de
la Ville de Nice, Nice, Vols 18 and 19, 1970, p 145-

Descriptors: \*Bacteria, \*Separation techniques, \*Filtration, \*Centrigugation, \*Filters, Isolation, Self-purification, Water purification, \*Pollutant identification.
Identifiers: \*Bdellovibrio, Pseudomonas.

To evaluate the ecological importance of Bdel-lovibrio, the organisms had to be isolated from different natural environments and their abundance estimated. Differential filtration of the sample through a membrane filter of 1.2 microns pore size for quantitation of attachment and penetration, and differential centrifugation in linear ficol gradients were performed. Eighty to ninety percent of the Bdellovibrios put on top of the gradient and centrifugated at 1620g for 20 minutes, were

recovered in the upper 3.5 ml of the gradient column. These techniques indicate promise for future quantiative assays on the abundance of Bdel-lovibrios in nature. Methods for quantification of different sequential stages in the life cycle of Bdel-lovibrio such as attachment to the host cell, penetration in its periplasm and intracellular growth and multiplication is also considered. (Ensign-PAI) W71-08729

FUNGUS PRODUCERS OF ANTIBIOTICS IN SEAWATER, (CHAMPIGNONS PRODUCTEURS D'ANTIBIOTIQUES DANS L'EAU DE MER),

Naples Univ. (Italy). Instituto di Igiena.
E. De Simone, E. Campanile, V. Ferro, R. De Fusco, and S. Grasso.

Revue Internationale d'Oceanographie Medicale, Dentre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Institut National de la Sante et de la Recherche Medicale, Foundation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 125-

Descriptors: \*Sea water, \*Fungi, \*Antibiotics, \*Bioindicators, \*Self purification, Pollutant identification, Water purification.

Ten years of research on the extraordinary disappearance of germ pathogens and indicators of fecal pollution in the littoral waters of Cuma, where physical, hydrological and meteorological conditions make dilution difficult, are reported. The biological factors which intervene in the self-purification of these waters, particularly the phenomenon of antipathy was examined. The antibiosis phenomenon has been thought not to take place in natural environments and in the presence of other microorganisms because there would be an infinite number of antibiotic-resistant strains. However, this study indicates that it is not impossible that the antibiotic-producing strains are capable of producing antibiotics in nature and in the presence of other microorganisms but their action is not manifested because they are destroyed very rapidly. (Ensign-PAI) W71-08731

OIL POLLUTION DETECTION AND DISCRIMINATION BY REMOTE SENSING SENSING CRIMINATION TECHNIQUES,

Spectran, Inc., Buena Park, Calif. Microwave Sensor Systems Div.
J. C. Aukland, and D. T. Trexler.

Available from the National Technical Information Service as AD-716 349, \$3.00 in paper copy, \$0.95 in microfiche. US Coast Guard Report No 714104/A/006-1, Washington, DC, Oct 1970. 166 p. 46 fig, 5 tab.

Descriptors: \*Oil wastes, \*Tracking techniques, \*Remote sensing, \*Aerial photography, \*Cameras, \*Infrared radiation, Temperature, Pollutant identification, Oily water.

Identifiers: Radiometer system specifications, Detection, Microwave radiometer temperatures.

Detection of oil pollution by using airborne remote sensing was performed in the Gulf of Mexico during April 1970. Number 2 fuel oil, number 6 fuel oil, 9250 lube oil, light crude oil, heavy crude oil, send oil and one priviting water oil. gasoline, and oil and gas mixtures were investigated. Two dual polarized microwave radiometers, an infrared scanner, a dual 70 mm camera and a 4-lens camera with filters from the mid-visible to ultraviolet wavelengths were used. (Ensign-PAI) W71-08745

AERIAL PHOTOGRAPHIC STUDIES OF THE COASTAL WATERS OF NEW YORK AND LONG ISLAND, Virginia Univ., Charlottesville. Dept. of Environmental Science; New York Univ., Bronx. Dept. of Biology.

Biology. Mahlon G. Kelly, and Louis Castiglione.

Available from the National Technical Information Service as AD-715 804, \$3.00 in paper copy, \$0.95 in microfiche. Nov 12, 1970. 52 p, 6 tab, 11 fig, 14 ref. USNOO Contract N62306-70-A-0073-0003.

Descriptors: \*Coasts, \*Aerial photography, \*Photography, \*Data collections, \*Water analysis, \*Benthos, Remote sensing, New York, Pollutant

identification.
Identifiers: Photoenhancement, Photo interpreta-tion, \*Long Island (NY).

Results from aerial photographic studies of the coastal waters of New York and Long Island are presented. Appropriate aerial photographs of the test sites and photoenhancement for quantitative analysis of the images were acquired. Measurement of oceanographic parameters such as suspended material concentrations, particle analysis, phytoplankton composition, chlorophyll concentration, salinity and temperature; the examination of benthic conditions; and continuous sampling of a tidal interface were conducted. Analysis of particle tidal interface were conducted. Analysis of particle and phytoplankton samples, mapping of benthic vegetation and reduction and interpretation of much of the data is incomplete. Sampling will continue in the Montauk Point, Chesepeake Bay, and Cape Hatteras areas for comparative studies. (Ensign-PAI) W71-08746

MONITORING ECOLOGICAL CHANGES IN THE MARINE ENVIRONMENT, Clapp (William F.) Labs., Inc., Duxbury, Mass. Robert E. Hillman.

Preprint Ecological Problems in the Marine Environment, 1st National Biological Congress, American Institute of Biological Sciences and Federation of American Societies for Experimental Biology, p 33-43, November 10, 1970, 1 fig, 1 tab.

Descriptors: \*Monitoring, \*Environmental effects, \*Oceans, \*Mathematical models, \*Ecosystems, Model studies, Biological communities, Control systems, Water pollution effects, Sampling, Data collections.

Many man-induced factors can produce relatively rapid changes in the marine environment. With increased uses of the marine environment, there is an increased need for effective monitoring of these changes. The problems are what to monitor, how to changes. The problems are what to monitor, now to monitor, and how to analyze data. Mathematical simulation models are one solution to these problems of predicting ecological changes and population responses. Mathematical models can be grouped into statistical models or deterministic models, but to develop the top-echelon model for a marine ecosystem up to five categories of models may be needed: hydrodynamic (flow) model, chemical-quality model, temperature model, atmospheric model, and biological (ecological) model. A brief explanation of the requirements of each of the physical environment models is given. A thorough examination of the less developed biological modeling is presented, including a table listing the data acquisition steps for a biological model. Results and projections of top-echelon models demand the interpretations of experienced ecologists, and, when properly used, can provide the most efficient approach to problems of monitoring ecological change in the marine environ-ment. (McEntyre-PAI) W71-08766

PHYSICAL DATA POTOMAC RIVER TIDAL SYSTEM INCLUDING MATHEMATICAL MODEL SEGMENTATION,

Federal Water Quality Administration, Annapolis, Md. Chesapeake Support Lab.

For primary bibliographic entry see Field 02L. W71-08774

BIOLOGICAL AND OCEANOGRAPHICAL SURVEY OF THE SANTA BARBARA CHANNEL OIL SPILL 1969-1970, VOLUME I:

#### Group 5A-Identification of Pollutants

BIOLOGY AND BACTERIOLOGY; VOL II: PHYSICAL, CHEMICAL AND GEOLOGICAL STUDIES.

University of Southern California, Los Angeles.

Allan Hancock Foundation.
For primary bibliographic entry see Field 05C.

OBSERVATIONS ON THE ZOOPLANKTON OF THE EASTERN SANTA BARBARA CHANNEL FROM MAY, 1969 TO MARCH, 1970, University of Southern California, Los Angeles.

For primary bibliographic entry see Field 05C. W71-08779

THE BENTHIC FAUNA IN THE SANTA BARBARA CHANNEL FOLLOWING THE JANUA-

RY, 1969, OIL SPILL, University of Southern California, Los Angeles. Allan Hancock Foundation. For primary bibliographic entry see Field 05C. W71-08780

SOME POLYCHAETOUS ANNELIDS FROM THE SANTA BARBARA SHELF AREA, University of Southern California, Los Angeles.

Allan Hancock Foundation. For primary bibliographic entry see Field 05C.

FECAL CONTAMINATION OF FRUITS AND VEGETABLES DURING CULTIVATION AND PROCESSING FOR MARKET, A REVIEW, Environmental Protection Agency, Cincinnati,

Ohio. Div. of Water Hygiene. Edwin E. Geldreich, and Robert H. Bordner

Journal of Milk and Food Technology, Vol 34, No 4, p 184-195, Apr 1971. 10 tab, 74 ref.

Descriptors: Water quality control, Water pollution sources, \*Standards, \*Public health, \*Environmensources, \*Standards, \*Public health, \*Environmental sanitation, \*Aquatic microbiology, Pathogenic microorganisms, Enteric bacteria, Salmonella, Adoption of practices, Irrigation water, Surface irrigation, Fruit crops, Vegetable crops, Soil contamination, Harvesting, Coliforms, \*Pollutant identification, \*Reviews.

Identifiers: \*Fecal contamination, \*Fecal coliforms, Microbiological methods, Raw vegetables Produce handling

bles, Produce handling.

Bacteriological data collected from various field studies involving irrigation water, field crops, and soils were studied with respect to sources and magnitude of fecal contamination associated with cultivation, harvesting, and marketing of fruits and vegetables. Other reports concerned with con-tamination during agricultural activities were reviewed. Fecal coliform densities proved to be a better measurement of the probable occurrence of waterborne pathogens than any single test for a specific pathogenic group. When the fecal coliform density per 100 ml was above 1,000 organisms in various stream waters, Salmonella occurrence reached almost 100 per cent frequency. These data support the establishment of the proposed limit of 1,000 fecal coliforms per 100 ml of irrigation water, but approved sanitation practices must accompany (or supplement) use of this bacteriological standard. A concept of multiple safeguards to limit the public health hazard associated with poor quality irrigation water, irrigation farming practices, and market preparation of produce is discussed from the microbiological viewpoint. (Geldreich-EPA) W71-08826

PULP MILL OUTFALL ANALYSIS BY REMOTE SENSING TECHNIQUES, Oregon State Univ., Corvallis. Dept. of Civil En-

gineering.

For primary bibliographic entry see Field 05B. W71-08829

AN AERIAL PHOTOGRAPHIC STUDY OF WASTE FIELD FROM THREE OCEAN OUT-FALLS,

Oregon State Univ., Corvallis. Dept. of Civil En-

For primary bibliographic entry see Field 05B.

THE USE OF PHOTOGRAMMETRY IN PRE-DICTING OUTFALL DIFFUSION, Oregon State Univ., Corvallis. Dept. of Civil En-

gineering.
For primary bibliographic entry see Field 05B.
W71-08832

## THE APPLICATION OF NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY TO PESTICIDE

Environmental Protection Agency, Athens, Ga.

Southwest Water Lab.

L. H. Keith, and A. L. Alford.
Varian Instrument Applications, Vol 5, No 1, Feb 1971, p 2-3. 7 ref.

Descriptors: \*Nuclear magnetic resonance, \*Pesticides, \*Reviews, \*Spectroscopy, Pollutant identification, Pesticide residues.

Identifiers: Pesticide metabolites, Pesticide photolysis products.

This review points out that NMR has been used successfully in pesticide analyses and supplies information difficult and sometimes impossible to obtain by other means. Applications listed are: pesticide residue analyses, elucidation of photolysis products, characterization of synthesized pesticide metabolites, studies of reaction and intermediate products, and structural elucidation of pesticides. Collections of pesticide spectra in the literature are listed. (See also W71-08834 thru W71-08836 and W71-08586 thru W71-08590) (Keith-EPA)

#### THE ENHANCEMENT OF ASYMMETRY EFFECTS IN NMR BY INTERMOLECULAR FECTS IN NMR BY HYDROGEN BONDING,

Environmental Protection Agency, Athens, Ga. Southwest Water Lab.

A. W. Garrison, L. H. Keith, and A. L. Alford.
Spectrochimica Acta, Vol 25A, No 1, p 77-84 (1969).

Descriptors: \*Nuclear magnetic resonance, \*Organophosphorus compounds, \*Hydrogen bonding, \*Spectroscopy, Analytical techniques, Pollutant

identification.
Identifiers: \*Chemical shifts, \*Coupling constants, Spin decoupling, Molecular asymmetry.

The doubling of the NMR signals of the isopropyl methyl protons in 2,4-dichlorophenyl methyl isopropylphosphoramidate has been shown to be due to a difference in chemical shift of the two methyl groups. This difference is ascribed to a steric hindrance to rotation about the N--C bond which enhances the inherent nonequivalence due to molecular asymmetry. Studies of the changes in chemical shift difference with changes in temperature, concentration and solvent show the steric hindrance to be due to intermolecular hydrogen bonding. The NMR data are correlated with infrared spectra of the phosphoramidate obtained under similar conditions; these spectra support the hydrogen bonding hypothesis. Possible hydrogen-bonded species are discussed. (See also W71-08833 (Garrison-GPA)

### EU (DPM)3 TRANSANNULARLY INDUCED PARAMAGNETIC CHEMICAL SHIFTS IN THE PMR SPECTRA OF ENDRIN, DIELDRIN, AND PHOTODIELDRIN,

Environmental Protection Agency, Athens, Ga. Southwest Water Lab. Lawrence H. Keith.

Tetrahedron Letters, No 1, 1971, p 3-6.

Descriptors: \*Nuclear magnetic resonance, \*Pesticides, Dieldrin, Endrin, \*Spectroscopy, Analytical techniques, Pollutant identification.

Identifiers: \*Chemical shifts, \*Coupling constants, Spin decoupling, \*Eu (DPM)3, Long-range coupling, Photodieldrin.

The PMR shift reagent Eu (DPM)3 was found useful for chemical shift and structural assignments of the epoxy derivatives of the chlorinated polycyclodiene pesticides and their degradation products. The stereochemistry of photodieldrin's H-12, which migrates during photorearrangement, was determined from a plot of the change of chemical shift versus the distance cubed of each proton in the molecule. Numerous examples of the non-'W' cal smit versus the distance cubed of each proton in the molecule. Numerous examples of the non-'W' as well as normal 'W' long-range couplings were observed. Presence of a transannular through-space coupling of a bridgehead proton with the migrated proton in photodieldrin confirmed the stereochemical assignment made on the basis of shifts from the Eu (DPM)3. (See also W71-08833) (Keith-EPA) (Keith-EPA) W71-08835

## LONG-RANGE COUPLINGS IN THE CHLORINATED POLYCYCLODIENE PESTI-

Environmental Protection Agency, Athens, Ga.

Southwest Water Lab.
Lawrence H. Keith, and Ann L. Alford. Tetrahedron Letters, No 28, 1970, p 2489-2492.

Descriptors: \*Nuclear magnetic resonance, \*Pesti-

bescriptors: "Nuclear magnetic resonance, "Pesti-cides, "Spectroscopy, Aldrin, Dieldrin, Endrin, "Chlorinated hydrocarbon pesticides, Pollutant identification, Analytical techniques. Identifiers: "Chemical shifts, "Coupling constants, Spin decoupling, Long-range coupling, Isodrin.

The NMR chemical shifts of the methylene protons of the chlorinated polycyclodiene pesticides aldrin, dieldrin, isodrin, and endrin were determined by decoupling experiments. NMR spectroscopy was found to be useful in differentiating between the exo-endo skeleton and the endo-endo skeleton. An unusual long-range coupling between the C-4 and C-5 protons and the syn methylene proton of compounds containing either the exo-epoxide or the C-C double bond was noted. The exo-configuration of the epoxide oxygen in dieldrin was confirmed. (See also W71-08833) (Keith-EPA) W71-08836

### SENSORS - STATE-OF-THE-ART, Geological Survey, Washington, D.C

James H. Ficken.

Identifiers: \*Water quality sensors.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 224-233, 1970. 10 p, 5 fig.

Descriptors: \*Telemetry, \*Data collections, \*Water quality, \*Monitoring, \*Instrumentation, Hydrogen ion concentration, Electrical con-ductance, Water temperature, Oxidation-reduction potential, Dissolved oxygen, Turbidity, Chlorides,

The water quality parameters most commonly measured and recorded by the U.S. Geological Survey are electrical conductivity, temperature, pH, and dissolved oxygen. Parameters less frequently moni-tored include turbidity, oxidation-reduction potential, chloride, and fluoride. This paper describes briefly some types of sensors now in use by the U.

S. Geological Survey for monitoring the water

quality in lakes, streams, and reservoirs. (See also W71-08550) (Knapp-USGS) W71-08872

TELEMETRY - STATE-OF-THE-ART. Geological Survey, Washington, D.C. George F. Smoot.

#### WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

#### Identification of Pollutants-Group 5A

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 234-242, 1970. 9 p, 1 fig.

Descriptors: \*Telemetry, \*Data collections, \*Water quality, Monitoring, \*Instrumentation, Hydrogen ion concentration, Electrical conductance, Water temperature, Oxidation-reduction potential, Dissolved oxygen, Turbidity, Chlorides, Fluorides.

Identifiers: \*Water quality sensors.

There are many choices available for designing a telemetering system, and the decision as to which is most satisfactory depends upon the specific need of the user. However, because needs and programs for water quality management are still evolving, any monitoring system should offer easy expansion as requirements change, and the flexibility to be converted to a more sophisticated system. With this approach, one can gain experience with a basic system, and expand as required. (See also W71-08550) (Knapp-USGS) W71-08873

#### DESIGN OF AN AUTOMATIC MONITORING

Geological Survey, Austin, Tex. Water Resources

James F. Blakey.
Proceedings of the National Symposium on Data
and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis., p 243-247, 1970. 5 p, 4 ref.

Descriptors: \*Telemetry, \*Data collections, \*Water quality, \*Monitoring, \*Instrumentation, Hydrogen ion concentration, Electrical conductance, Water temperature, Oxidation-reduction potential, Dissolved oxygen, Turbidity, Chlorides, Fluorides.

Identifiers: \*Water quality sensors.

To provide the required data as soon as possible, the U. S. Geological Survey continuously tests, evaluates, and applies modern analytical tools and approaches. One of the most important analytical tools adopted by the Survey in recent years is the automatic water quality monitor. This paper describes the development, design, and operation of such units. The Survey presently has some 300 water quality monitors in operation, including 125 multiparameter potentiometric systems, 150 resistance-type units, and about 30 analog strip chart monitors. The single most important factor in monitor operations is trained field personnel. The Survey's training program includes individual instruction in all phases of monitor installation and operation. The reliability of monitoring equipment is gradually improving. The Survey installs, operates, and improves monitors as the need for data increases and as the state-of-the-art allows. (See also W71-08550) (Knapp-USGS) W71-08874

#### EXPERIENCES WITH OPERATING AN AUTO-MATIC WATER QUALITY MONITORING SYSTEM IN AN ESTUARINE ENVIRONMENT, Federal Water Quality Administration, Edison, N.J. Hudson-Delaware Basins Office.

Albert W. Bromberg, and Manuel Carames.
Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 248-255, 1970, 8 p, 2 fig, 1 ref.

Descriptors: \*Telemetry, \*Data collections, \*Water quality, \*Monitoring, \*Instrumentation, Hydrogen ion concentration, Electrical conductance, Water temperature, Oxidation-reduction potential, Dissolved oxygen, Turbidity, Chlorides, Fluorides.

Identifiers: \*Water quality sensors.

Since 1963 the Federal Water Quality Administration, Hudson-Delaware Basins Office, has operated a network of four automatic water quality monitors in the New York Harbor area. A fifth station was installed in late 1969. Water quality monitoring ininstalled in late 1969. Water quality monitoring in-strumentation was originally installed as a surveil-lance mechanism for two Federal Enforcement Conferences (Raritan Bay and Hudson River and New York Harbor) and is also providing vital historical data. Each monitor consists of a flow cell cubicle, an analyzer cubicle capable of holding eight parametric modules and a telemeter cubicle. Sample intake pumps are located at 5 feet above the bottom, mid-depth and 5 feet below the surface (mean tide level). On the average, valid water quality data are presently obtained 91% of the time. Of the 9% loss, approximately half is due to down time of the teletype lines, and the remainder is due to monitor equipment breakdown or malfunction. All monitoring stations are linked together in series with the central receiving station on a commercial leased teletype line. (See also W71-08550) (Knapp-USGS)

NEW YORK STATE AUTOMATIC WATER QUALITY MONITORING SYSTEM,
New York State Dept. of Health, Albany. Water Quality Surveillance Section.
Ronald E. Maylath.
Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 256-260, 1970. 5 p.

Descriptors: \*Telemetry, \*Data collections, \*Water quality, \*Monitoring, \*Instrumentation, \*New York, Hydrogen ion concentration, Electrical conductance, Water temperature, Oxidation-reduction potential, Dissolved oxygen, Turbidity, Chlorides, Fluorides. Identifiers: \*Water quality sensors.

The New York water quality surveillance network consists of approximately 200 active surface water sampling stations. The automatic monitoring system for New York's waters is designed to be highly reliable with a minimum of maintenance. The system consists of three basic parts; monitor, telemeter, and computer. Environmental parameter equipment measures pH, dissolved chlorides, dissolved oxygen, dissolved fluorides, conductivity, water temperature, turbidity, water stage height, solar radiation intensity, and air temperature. Environmental parameter alarms detect parameter values exceeding a preset limit and automatically collect a water sample. Functional command equipment allows remote control of various components in the monitor. (See also W71-08550) (Knapp-USGS) W71-08876

## AUTOMATED STREAM QUALITY SENSING NETWORK IN NEW JERSEY, Geological Survey, Trenton, N.J. Water Resources

Peter W. Anderson, John J. Murphy, and Samuel D. Faust.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 261-281, 1970. 21 p, 12 fig, 2 tab, 2 ref.

Descriptors: \*Telemetry, \*Data collections, \*Water quality, \*Monitoring, \*Instrumentation, \*New Jersey, Hydrogen ion concentration, Electrical conductance, Water temperature, Oxidation-reduction potential, Dissolved oxygen, Turbidity, Chlorides, Fluorides.

Identifiers: \*Water quality sensors.

The automatic stream quality sensing network in New Jersey consists of ten stations located throughout the state. Four stations have twoparameter sensing units. The remaining stations are equipped with five-parameter units. Two of the

five-parameter units are located at river confluences so that one instrument can record the water quality of two streams. The two-parameter unit measures specific conductance and water tem-perature. The package consists of a Fisher Porter automatic digital recorder (ADR), a Chelsea timer, a Beckman servo-programmer, and two sensors. The five-parameter unit measures specific conductance, water temperature, pH, turbidity, and dissolved oxygen. (See also W71-08550) (Knapp-W71-08877

### ERRORS TO AVOID IN WATER QUALITY COLLECTION AND SAMPLING,

Bureau of Reclamation, Sacramento, Calif. Melvin Douglas Ball.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis., p 283-292, 1970. 10 p.

Descriptors: \*Data collections, \*Sampling, \*Water quality, Monitoring, Data processing, Planning, Design, Hydrologic data, On-site tests, Analytical techniques, Calibrations, Instrumentation, Data storage and retrieval. Identifiers: \*Water quality data.

The collection of valid data from representative sampling sites is essential for every water quality data collection program. Time and effort spent collecting invalid or nonrepresentative data is wasted. Numerous environmental factors such as prevailing winds, flows, stratifications, water depths, waste discharges, tides, confluence of tributaries, seasons, and time of year must be examined and considered in the selection of sampling locations. Cross-sectional measurements should be conducted to determine the most representative sites. The special precautions required in collecting devices, containers, preservatives, and storage procedures used are reviewed. Instruments must always be properly calibrated, sufficiently powered, and used correctly. (See also W71-08550) (Knapp-W71-08878

#### ERRORS TO AVOID IN COLLECTION AND

SAMPLING, Interstate Sanitation Commission, New York.

Thomas R. Glenn, Jr.
Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis., p 293-298, 1970. 6 p.

Descriptors: \*Data collections, \*Sampling, \*Water quality, Monitoring, Data processing, Planning, Design, Hydrologic data, On-site tests, Analytical techniques, Calibrations, Instrumentation, Data storage and retrieval. Identifiers: \*Water quality data.

When any sampling program is undertaken, it is extremely important that the data be correct. If the data of a regulatory agency is to be used in court, highly experienced lawyers try to discount every procedure and analysis used by the regulatory agency. Therefore, good sampling, collection and analysis practices are a must. It is important that the sample be as homogeneous as is possible and that it be representative of the sampling point. In order to accomplish this, samples should be composited over a period of time to reduce the chance of abnormal instantaneous values. Also, if samples are not analyzed at the sampling site, they should be kept under conditions so as not to change their composition. In the case of BOD, refrigeration is suitable whereas for coliform determination (MPN's) refrigeration is not suitable but immediate planting is necessary. In setting up continuous monitoring equipment, it is important that the readings be representative of the areas and not just the point at which they are taken. Other problems

#### Group 5A—Identification of Pollutants

associated with continuous monitoring are those of calibration and maintenance and the manpower needed to keep the monitors properly maintained. (See also W71-08550) (Knapp-USGS)

#### **EVALUATION** HYDROBIOLOGICAL STREAM AND NEARSHORE SYSTEMS: FIELD

Michigan State Univ., East Lansing. Inst. of Water

M. E. Stephenson, E. D. Anderson, and R. A. Cole. Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis., p 299-309, 1970. 11 p, 3 fig, 1 tab.

Descriptors: \*Monitoring, \*Water quality, \*Bioindicators, Sampling, Michigan, Water pollution effects, Pollutant identification, Thermal pollution, Lake Erie, Plankton, Aquatic life, Ecology, Aquatic environment. Identifiers: \*Water quality monitoring.

Hydrobiological evaluations may be conducted under the assumption that the most representative indicators of changing water quality are functions of the indigenous biological community. These responses may occur as a result of the introduction of foreign biological populations or change in physical and chemical properties. Field investiga-tions were made on four Michigan stream systems and a nearshore environment in western Lake Erie to evaluate the response of these environments to urbanization and agriculture practices. An ecological evaluation of thermal discharge from a fossil fuel power plant at the mouth of the Raisin River in western Lake Erie was initiated in July, 1969. Community components elected to characterize changes are phytoplankton, periphyton, zooplankton, benthos, fish, and waterfowl. The physical and chemical parameters include temperature, oxygen, phosphorus, organic nitrogen, total nitrogen, nitrate, ammonia, organic carbon, and silica. In addition, pesticide analyses are being performed on the fish collected in the biological program. (See also W71-08550) (Knapp-USGS) W71-08880

#### A NOTE ON SAMPLING IN WATER QUALITY

STUDIES, Federal Water Quality Administration, Edison, N.

Henry P. Shotwell.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis., p 310-312, 1970. 3 p.

Descriptors: \*Sampling, \*Data collections, \*Water quality, \*Statistical methods, Estimating, Estimating, Heterogeneity, Homogeneity, Hydrologic data, Measurement, Reliability, Variability. Identifiers: \*Water quality data.

The type of water sample to be taken, and the proper sample size are discussed. If no advance information is available about the distribution, in the water, of the parameter or variable being studied, then a simple random sample is probably the best type to take. If the body of water being sampled is known to be heterogeneous, and this fact has a bearing on the parameter being studied, then a stratified random sample is indicated. In order to determine proper sample size, the desired confidence coefficient and confidence interval must be specified. In addition, some estimate of the population variance must be obtained, either from past experience or from a pilot study. Specifying a higher coefficient of confidence will also increase the required sample size, other things being equal. (See also W71-08550) (Knapp-USGS)

ON THE ANALYSIS AND USE OF WATER QUALITY DATA,

Kansas State Univ., Manhattan. Dept. of Chemical Engineering

L. T. Fan, J. S. Shastry, and L. E. Erickson.

Proceedings of the National Symposium on Data
and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis., p 313-324, 1970. 12 p, 3 fig, 1 tab, 9 ref.

Descriptors: \*Data collections, \*Water quality, \*Statistical methods, \*Systems analysis, Time series analysis, Correlation analysis, Frequency analysis

Identifiers: \*Water quality data.

One of the primary reasons for water quality data collection is that of enforcement of water quality standards. Water quality data are also very useful to those investigating the ecology of streams and estuaries. Systems analysis techniques such as parameter estimation and spectral analysis may be used in the analysis of data and construction of models that enable the investigator to better understand the assimilative capacity of the stream and the effect of discharges on stream ecology. Water quality data may be collected continuously, periodically at frequent specified time intervals, or occasionally at infrequent time intervals. Spectral analysis requires a large volume of data at a very small sampling interval. The shortest period that is necessary to resolve determines the sampling interval, and the longest period necessary determines the total record length. (See also W71-08550) (Knapp-USGS) W71-08882

## ORGANIZING A DATA COLLECTION PROGRAM FOR WATER RESOURCES PLANNING, DEVELOPMENT AND MANAGEMENT,

Geological Survey, Washington, D.C. D. W. Moody.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 325-335, 1970. 11 p, 1 fig, 1 tab, 5 ref.

Descriptors: \*Systems analysis, \*Data collections, \*Sampling, \*Monitoring, \*Water quality, Statistics, Statistical methods, Planning, Water resources development, Frequency analysis, Mathematical

Identifiers: \*Water quality data.

This paper examines the type of interaction that should take place between the water resources planner, designer, and manager and the data collector. The design of a data collection program presupposes knowledge of the sensitivity of a particular planning model to variance in the hydrologic input. If this is known, appropriate hydrologic models, analytical, tachniques, and accuracy models, analytical techniques, and accuracy requirements can be specified that will define the required sampling program. The data program organizer usually establishes data program objectives and accuracy requirements subjectively either through conversations with the water resources planner or by intuitive reasoning. An alternative approach would require the program organizers to examine different classes of available planning models and their accuracy requirements. (See also W71-08550) (Knapp-USGS) W71-08883

#### A WATER QUALITY INDEX - DO WE DARE.

National Sanitation Foundation, Ann Arbor, Mich; and Michigan Univ., Ann Arbor. School of Public Health; and Michigan Univ., Ann Arbor. School of Natural Resources

Robert M. Brown, Nina I. McClelland, Rolf A. Deininger, and Ronald G. Tozer.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 364-383, 1970. 20 p. 4 fig, 8 tab, 7 ref. Descriptors: \*Surveys, \*Water quality, \*Conferences, Statistical methods, Pollutant identification, Water pollution control, Water quality con-

Identifiers: \*Surveys (opinion), \*Questionnaires, \*Water quality index.

Based on a survey of water pollution workers, a single numerical expression which reflects the composite influence of significant parameters of water quality is proposed. The index provides a meaningful, uniform method for assessing the overall quality of a stream, comparing stream conditions at different points in space and time, and measuring progress in water pollution abatement programs. The eleven most significant parameters are dissolved oxygen, biochemical oxygen demand, turbidity, total solids, nitrates, phosphates, pH, temperature, fecal coliforms, pesticides, and toxic elements. (See also W71-08550) (Knapp-USGS) W71-08884

### WATER QUALITY MANAGEMENT DATA ASSOCIATED WITH RESERVOIR OPERATIONS, Corps of Engineers, Washington, D.C. Kenneth S. Eff.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 384-394, 1970. 11 p, 11 ref.

Descriptors: \*Data collections, \*Sampling, \*Water quality, \*Reservoir operation, \*Reservoir design, Reservoir stages, Water quality control, Water pollution control, Monitoring, Surveys. Identifiers: \*Water quality data.

Water quality data collection is needed for reservoir planning and design and to evaluate conditions in four phases of water resource development: (1) prior to impoundment, (2) during construction, (3) on completion of construction, and (4) as a continuing function of reservoir operations. Preimpoundment data should cover all parameters, thermal, chemical and biological, to assure a sound basis for planning and design and for evaluating changes attendant to and resulting from the construction and operation of the reservoir. During construction, it is important to monitor the effect of the contractors' operations on water quality. This includes observation of sediment deposits After construction, sampling provides guidance during operations for comparison with the preimpoundment data. (See also W71-08550) (Knapp-USGS) W71-08885

#### APPLICATION OF ELECTRONIC MONITORS

TO RIVER QUALITY FORECASTING, Ohio River Valley Water Sanitation Commission, Cincinnati.

R. J. Boes.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 395-405, 1970. 11 p, 3 fig.

Descriptors: \*Monitoring, \*Water quality, \*Ohio River, Dissolved oxygen, Hardness (Water), Sulfates, Alkalinity, Water pollution control, Pollutant identification, Probability, Mathematical models, Forecasting, Statistical methods, Variabili-

Identifiers: \*Water quality data.

Electronic monitor systems are aids to water quality management. Methods are available for the continuous evaluation of the influence of such factors as municipal and industrial waste water discharges, hydropower generation, tributary streams, surface runoff and storm overflows for the prediction of resultant water quality conditions in the receiving streams. The ninety-five mile Markland Pool and the downstream seventy-three miles McAlpine Pool of the Ohio River encompass sections of a river system that offer opportunity for detailed study of factors influencing stream quality. Initial statistical evaluation of interparameter relationships shows that the electronic monitor values provide information for the estimation of total hardness, sulfate and dissolved solids concentrations with acceptable accuracy and may be of value for estimating alkalinity levels. (See also W71-08550) (Knapp-USGS) W71-08886

WATER QUALITY MODELLING WITH SUB-MERSIBLE RECORDING WATER QUALITY AND CURRENT METERS, Ontario Water Resources Commission, Toronto.

Mater Quality Surveys Branch.
M. D. Palmer, and J. B. Izatt.
Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 406-418, 1970. 13 p, 4 fig, 2 tab, 6 ref, ap-

Descriptors: \*Mathematical models, \*Water pollution effects, \*Path of pollutants, \*Monitoring, \*Great Lakes, Markov processes, Time series analysis, Dispersion, Current meters, Water quality, Water chemistry, Data collections, Correlation analysis, Frequency analysis, Variability. Identifiers: \*Water quality data, Ontario (Canada), Canada

The Ontario Water Resources Commission is developing mathematical assimilation models for the nearshore areas of the Great Lakes. Good water management requires the models to assist in location of water intakes and waste outfalls with a minimum of interference with water users. Modelling is complicated in the nearshore areas of the Great Lakes as water environmental charcteristics have been found to be variable in both time and space. The physical characteristics of current and temperature were modelled in two dimensions by applying time series analysis and Markov Chain techniques to recording current meter data. These models are capable of predicting the distribution of passive contaminants. The time series method generates monthly mean dispersion characteristics while the Markov chain process depicts hourly dispersion patterns. (See also W71-08550) (Knapp-USGS) W71-08887

#### MINICOMPUTERS AND WATER QUALITY SURVEILLANCE, Minneapolis-St. Paul Sanitary District, St. Paul,

Minn.

James J. Anderson.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 420-429, 1970, 10 p, 1 fig, 2 tab, 23 ref.

Descriptors: \*Digital computers, \*Data processing, \*Hydrologic data, \*Water quality, \*Data collections, Telemetry, Instrumentation, Sampling, Monitoring, Dissolved oxygen, Automation, Electrical conductance, Data storage and retrieval Water management (Applied), Systems analysis, Mathematical models, Simulation analysis. Identifiers: \*Water quality data.

The newly developed minicomputer offers the opportunity for improvements in water quality data acquisition and monitoring. These devices are suitable for use with conventional parametric water quality monitoring stations and for use with other more complicated process stream analyzers. While automated data acquisition cannot be compared directly with historical manual methods, the costs for achieving similar objectives have reached similar orders of magnitude and are roughly comparable in certain cases. The typical minicomputer costs about \$10,000, weighs about 50 pounds, and occupies a space of a little more than 2 cubic feet. These machines provide computing speeds measured in microseconds and computing and control capabilities equivalent to machines costing ten times as much only a few years ago. This may result in cost-effectiveness improvement of about 800 to 1. (See also W71-08550) (Knapp-USGS)

#### THE WATER MANAGEMENT INFORMATION

SYSTEM (WAMIS), Spindletop Research, Inc., Lexington, Ky. James A. Sena.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 430-439, 1970. 10 p, 5 fig.

Descriptors: \*Digital computers, \*Data processing, \*Hydrologic data, \*Water quality, \*Data collections, Telemetry, Instrumentation, Sampling, Monitoring, Dissolved oxygen, Automation, Elec-Water management (Applied), Systems analysis, Mathematical models, Simulation analysis. Identifiers: \*Water quality data.

The Water Management Information System was developed for the Commonwealth of Kentucky with the aid of a grant from the Water Resources Council. The system uses an IBM 360/65 at the University of Kentucky. WAMIS is intended for use primarily by the managers of Kentucky's water resources. In many cases broad indications can be given to even the engineer for such studies as small watershed analyses. The system makes it possible for the manager to identify water-related problems, to evaluate alternative solutions to these problems, and to determine existing or future attributes of data carried in the system concerning a particular location. The data base currently consists of data on population, employment, water demand, and water supply. Provisions were made to include recreation, water quality, and flood control data. (See also W71-08550) (Knapp-USGS) W71-08889

#### EXPERIENCE WITH COMPUTER USE IN MANAGING WATER QUALITY DATA IN THE DELAWARE RIVER BASIN,

Geological Survey, Philadelphia, Pa.

Richard W. Paulson.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 454-467, 1970. 14 p, 8 fig, 2 ref.

Descriptors: \*Digital computers, \*Data processing, \*Hydrologic data, \*Water quality, \*Data collections, \*Delaware River Basin Commission, Telemetry, Instrumentation, Sampling, Monitoring, Dissolved oxygen, Automation, Electrical conductance, Data storage and retrieval, Water management (Applied), Systems analysis, Mathematical models, Simulation analysis. Identifiers: \*Water quality data.

The U.S. Geological Survey's Water Resources Division office in Philadelphia, Pennsylvania, operates a system of eleven water quality monitors in the Delaware River basin. The objective of the system is to continuously monitor the water quality parameters of dissolved oxygen concentration, specific conductance at 25 deg C, temperature, and pH. This paper briefly summarizes the data processing system devised to process, edit, and summarize these water quality monitor data. The objective of this data processing system is to provide water resources agencies in the basin with water quality data in a concise and unable form on a reasonably current basis. The system also makes available, in a computer-compatible format, water quality data for scientific and engineering studies of water resources in the basin. (See also W71-08550) (Knapp-USGS) W71-08890

BENEFICIAL USES AND PITFALLS OF HISTORICAL WATER-QUALITY DATA, Geological Survey, Washington, D.C. Timothy Doak Steele.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis., p 346-363, 1970. 18 p, 3 fig, 5 tab, 4 ref.

Descriptors: \*Data collections, \*Water quality, \*Data processing, Planning, Systems analysis, Statistical methods, Sampling, Statistics. Identifiers: \*Water quality data.

Many water-quality data have been gathered in the past twenty years. Emphasis on data processing and storage often obscures efforts to derive the full benefit of the information. Data analysis is a necessary link between routine computer processing of water-quality data and data evaluation. In evaluation the information derived from the information derived from the part of th tion, the information derived from data is tested against the stated or implied objectives of the data-collection program, and alternate indirect methods collection program, and alternate indirect methods at reduced cost are sought for providing information fulfilling the objectives that are satisfied directly using actual data. The application of several statistical techniques to the analysis of historical records of streamflow inorganic chemical quality is described. Results from data analysis of numerous records suggest that data-collection activities of inorganic constituents often might be reduced without substantial loss of information, thus allowing funds and manpower to be redirected to the collection and analysis of other types of data. (See also W71-08550) (Knapp-USGS) W71-08891

## POTENTIAL BENEFITS OF MATHEMATICAL MODELS AND COMPUTERS FOR WATER QUALITY MANAGEMENT PROGRAMS, New York Univ., N.Y. Dept. of Civil Engineering.

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis., p 440-453, 1970. 14 p, 1 fig, 48 ref.

Descriptors: \*Digital computers, \*Data processing, \*Hydrologic data, \*Water quality, \*Data collections, Telemetry, Instrumentation, Sampling, Monitoring, Dissolved oxygen, Automation, Electrical conductance, Data storage and retrieval, Water management (Applied), Systems analysis, Mathematical models, Simulation analysis. Identifiers: \*Water quality data.

For the effective and economic operation of water quality management programs, it is desirable to coordinate manual field and laboratory studies, automatic monitoring, and mathematical model investigations. This paper reviews the problem areas for which the techniques of mathematical modeling are well advanced. The improvement of data collection programs, particularly those involving automatic monitoring should be undertaken through research and application of mathematical methods and the electronic computer. (See also W71-08550) (Knapp-USGS)

#### HYDROLOGIC DATA UTILIZATION IN FORECASTING THE SPRING 1969 MIDWEST SNOWMELT FLOODS, UTILIZATION

Environmental Science Services Administration, Kansas City, Mo., Weather Bureau River Forecast

For primary bibliographic entry see Field 02E. W71-08893

#### COMPUTERIZED PROMICHIGAN'S WATER PROGRAMS FOR TER MANAGEMENT SYSTEM.

Michigan Water Resources Commission, Lansing; and Ernst and Ernst, Detroit, Mich. Gary E. Guenther, and Stuart Egan.

#### Group 5A—Identification of Pollutants

Proceedings of the National Symposium on Data and Instrumentation for Water Quality Management, Conference of State Sanitary Engineers and Wisconsin University, July 21-23, 1970, Madison, Wis, p 482-489, 1970. 8 p, 5 ref.

Descriptors: \*Data storage and retrieval, \*Data processing, \*Hydrologic data, \*Water quality, \*Michigan, Digital computers, Data collections, Monitoring, Water pollution control, Water management (Applied). Identifiers: \*Water quality data.

The digital computer eases the solution of several problems in the field of pollution control, particularly those which involve repetitive operations. Two examples of these are the calculation of dis-solved oxygen profiles for waste assimilation analyses and the calculation of water surface profiles for flood plain determination. Michigan's programs for water-management systems include: operating reports concerning quality and quantity of effluent or intake; reports of staff visits; reports of staff surveys at which quality and quantity data were collected; reports of property tax exemption status for pollution control devices; reports of annual performance rating; reports of all Commission actions concerning hearings and orders; reports of performance due, such as date of start of construction; and reports of judicial action, such as filing of briefs. (See also W71-08550) (Knapp-USGS) W71-08894

CATALOG OF INFORMATION ON WATER DATA, EDITION 1970 - INDEX TO AREAL INVESTIGATIONS AND MISCELLANEOUS WATER DATA ACTIVITIES.
Geological Survey, Washington, D. C. Office of Water Data Coordination.

Resources Div.

For primary bibliographic entry see Field 07C. W71-08922

NATIONAL REFERENCE LIST OF WATER QUALITY STATIONS-WATER YEAR 1971. Geological Survey, Washington, D. C. Water

Geological Survey National Reference List of Water Quality Stations, 1971. 825 p, 7 tab, index.

Descriptors: \*Water quality, \*Surface waters, \*Data collections, \*United States, \*Information retrieval, Reviews, Water chemistry, Chemical properties, Physicochemical properties, Chemical analysis, Water temperature, Sediments, Sampling, Projects, Hydrologic data, Documentation, Data storage and retrieval, Streams, Lakes, Reservoirs, Data processing.

Identifiers: \*National reference list, \*Water quality stations.

The water-quality stations listed in this volume (1971 water year) are maintained by the U.S. Geological Survey in cooperation with other agencies for the collection of basic data on the chemical, biological, microbiological, and physical characteristics of streams, lakes, and reservoirs in the United States and its territories. The stations are listed in three sections; in alphabetical order by State, in downstream order by part (major drainage basins), and stations that discontinued operations at the end of the previous water year. Data listed for each station consist of: Identification number, latitude and longitude, station name, drainage area. State, county, date established, type of data collected (chemical, sediment, temperature), available discharge records, frequency of smapling, type of project, source of operating funds, number of years the station has been in operation, and the constituents determined by analysis in the laboratory, in the field, or by digital monitor. The data collected from stations on this list may be obtained by writing the U. S. Geological Survey, Water Resources Division, Automatic Data Processing Unit, Washington, D. C. 20242. (Woodard-USGS) W71-08937

#### 5B. Sources of Pollution

ESTUARINES, BAYS AND COASTAL CURRENTS AROUND PUERTO RICO,
Puerto Rico Univ., Mayaguez. School of Engineer-

Puerto Rico University Water Resources Research Institute Partial Technical Completion Report 2, Mar 1971. 15 p, 3 fig. OWRR Project A-031-PR

Descriptors: \*Ocean currents, \*Data collections, \*Path of pollutants, \*Instrumentation, \*Puerto Rico, Measurement, Water temperature, Velocity, Bays, Estuaries, Municipal wastes, Industrial

For many years, domestic and industrial wastes have been discharged along the coastal waters of Puerto Rico without adequate treatment in most cases. This report presents data concerning movement of coastal waters along Puerto Rico to better understand the path of pollutants. Model 502 insitu current direction, temperature, and velocity meters were used during half-moon cycle periods to collect the data. The information can be utilized in further studies using relevant data such as tide tables, tidal current tables, moon phases and wind weather bureau information sources. (Woodard-USGS) W71-08322

MERCURY IN THE ENVIRONMENT--SURFI-CIAL MATERIALS OF THE CONTERMINOUS

UNITED STATES, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 05A. W71-08326

DETECTION OF OIL SLICK POLLUTION ON WATER SURFACES WITH MICROWAVE RADIOMETER SYSTEMS,

Microwave Sensor Systems, Inc., Downey, Calif.; and California Univ., Santa Barbara. For primary bibliographic entry see Field 05A. W71-08361

MULTISPECTRAL SENSING OF OIL POLLU-

Michigan Univ., Ann Arbor. For primary bibliographic entry see Field 05A. W71-08363

AN INVESTIGATION OF INDUSTRIAL AND MUNICIPAL WASTE WATER QUANTITY, COMPOSITION, AND TREATMENT IN THE REEDY RIVER BASIN,

Clemson Univ., S.C. Environmental Systems Engincering Program. For primary bibliographic entry see Field 05D. W71-08424

LITERATURE SURVEY: THE USE OF BACTERIA AS INDICATORS OF FAECAL POLLU-

TION IN WATER,
Council for Scientific and Industrial Research, Pretoria (South Africa). National Inst. for Water

W. O. K. Grabow

CSIR special Report O/WAT 1, p 1-27, UDC 543.39:628.19. 74 ref.

Descriptors: \*Bioindicators, Water quality, control, Coliforms, E. Coli, Enteric bacteria, Pathogenic bacteria, Bacteria, Salmonella, Streptococcus, Analytical techniques, Separation techniques, Sampling, Meus-membrane filters, \*Pollutant identification, \*Reviews. Identifiers: \*Faecal coliforms

Study and discussion revealed the fact that although positive tests for certain indicator organisms, such as faecal streptococci and E. coli I. indicate the presence of pollutant at some unspecified time in the past, a negative result on tests provides no information whatsoever. Also, positive results provide no concrete and definite information that the waters from which the organisms were isolated were polluted. Indicator organisms have been assumed to be always present in faecal materials, and to die off more slowly than any of the pathogenic bacteria. However, the complexity of factors which determine bacterial kinetics is such that generalizing is very dangerous. Each different that generalizing is very dangerous. Each different situation occasions a different response from different bacteria. Artificial filtration procedures such as chlorination, filtration, and floculation may remove enough bacteria to allow bacteriological examination to certify the water as safe to drink, even though it was recently polluted. Therefore, although indicator organisms are a useful tool for casting supplicion on waters which casting suspicion on waters which may or may not be contaminated, use of indicators alone will not determine whether the water is safe. Presence of indicators, should be the signal for more comprehensive investigations. (Lowry-Texas)
W71-08425

TRANSPORT PROCESSES OF PARTICLES IN DILUTE SUSPENSIONS IN TURBULENT DILUTE SUSPENSIONS IN TURBULE WATER FLOW - PHASE I, Illinois Univ., Urbana. Water Resources Center.

For primary bibliographic entry see Field 08B. W71-08492

WATER QUALITY STUDY OF THE POPLAR RIVER, DOUGLAS COUNTY, WISCONSIN - TRIBUTARY TO LAKE SUPERIOR,

Wisconsin State Univ., Superior. Dept. of Chemistry; and Wisconsin Univ., Madison. Water Resources Center.

Donald A. Bahnick, Joseph W. Horton, and Ronald K. Roubal.

Reprint, Proceedings, 13th Conference Great Lakes Research, 651-658, International Association Great Lakes Research, 1970, 8 p, 4 fig, 1 tab, 3 ref. OWRR Project A-023-WIS (9).

Descriptors: \*Nutrients, \*Chemical analysis, \*Water quality, \*Dissolved oxygen, \*Chemical oxygen demand.

ygen demand: Identifiers: \*Inorganic constituents, \*Electrical characteristics, Poplar River, Bois Brule River, Lake Superior, Douglas County, Wisconsin.

Chemical parameters for the Poplar River, Wisconsin (35 square mile drainage) are presented. Parameters determined were nitrogen, phosphorus, copper, dissolved oxygen, chemical oxygen demand, specific conductance, color value, total solids, and pH. The results indicate that the water quality of the Poplar River is high. Comparison of these results with those obtained previously for the Bois Brule River, Douglas County, shows only small differences in the chemical parameters which are ascribed mainly to differences in the size and nature of the two drainage basins. The Bois Brule River has a larger drainage basin and drains extensively marshy regions, while the basin of the Poplar River encompasses largely Pleistocene red clay areas. Both rivers are tributary to Lake Superior. W71-08495

DISTRIBUTION OF SELECTED METALS IN BOTTOM SEDIMENTS.

Illinois Univ., Urbana. Water Resources Center.

B. J. Mathis, and T. F. Cummings.

Available from the National Technical Information Service as PB-199 713, \$3.00 in paper copy, \$0.95 in microfiche. Water Resources Center, University of Illinois, Urbana, Research Report No 41, UILU-71-0041, Mar, 1971. 45 p, 25 fig, 6 tab, 5 ref. OWRR Project A-034-ILL (1).

Descriptors: Water pollution sources, \*Heavy metals, \*Biota, Illinois River, Copper, Nickel, Iron, Calcium, Lead, Chromium, Potassium, Magnesium, Lithium, Sodium, Zinc, Cobalt, Cadmium,

#### Sources of Pollution—Group 5B

Atomic absorption spectrophotometry, \*Benthos, \*Aquatic environment, Linology, \*Food chain,

This study was designed to assess the potential application for further research of metal contamination in a large mid-western river that is utilized by industries and certain cities as a source of potable water as well as for sewage disposal. Analyses were made for thirteen metals in bottom sediments, twelve in water, and ten in tubificid worms, clams, and fishes. The study revealed that the ten metals. for which analyses were made in biota, do not concentrate along successive trophic levels as is the case with pesticides. Organisms such as clams and worms that inhabit the mud or mud-water interface where metal concentrations were observed to be the highest, exhibited the highest metal concentrations. At higher trophic levels, however, concentra-tions were lower, with fishes that are primarily carnivorous in nature exhibiting the lowest concentra-tions. The problem of metal contamination in aquatic systems is just now being recognized as a potential hazard to human health while the degree to which aquatic biota are affected remains speculative. This study, basically a pilot study, outlines procedures by which similar studies can be made and provides data that others may use in assessing the degree of metal contamination in multiple use rivers. W71-08497

## LAKE AND RIVER POLLUTION, AN ANNOTATED BIBLIOGRAPHY,

Evelyn Sinha.

Available from Ocean Engineering Information Service, PO Box 989, La Jolla, California 92037, \$15.00. Ocean Engineering Information Series No 4, 1971, 85 p.

Descriptors: \*Bibliographies, Lakes, Rivers, \*Water pollution sources, \*Water quality control, \*Water pollution effects, Pollutant identification, \*Abstracts, Path of pollutants, Pollution abate-

Identifiers: Water quality management.

This bibliography contains 601 abstracts of literature providing scientific and technical information obtained from local and regional studies in laboratory and field investigations. tory and field investigations of lake and river pollution. These deal with the parameters of pollution and pollutants; the agricultural, atmospheric, domestic, and industrial sources of pollution and with effects of engineering activities; hydrological, geological and meteorological processes involved in understanding the paths of pollutants; the effects of pollution on fishes, invertebrates including in-sects, macrophytes, plankton, zooplankton, bac-teria, fungi, viruses and yeasts, birds, and on human health. Trends in water quality management are also considered. A bibliography of bibliographies, a detailed subject outline, a keyterm index and an index citing all authors and coauthors are included. Represented are world wide sources found in 144 journals, some 25 national and international conferences and more than 80 additional sources consisting of governmental research reports, institu-tional and industrial contract reports. Intended as a guide in interdisciplinary studies of lake and river pollution. Coverage 1968-1970 inclusive. W71-08498

MERCURY IN THE ENVIRONMENT-THE HUMAN ELEMENT, Oak Ridge National Lab., Tenn. Robin A. Wallace, Wilbur D. Shults, William Fulkerson, and William S. Lyon. Report ORNL NSF-EP-1, Jan, 1971. 61 p. 14 fig. 19 tab, 280 ref. AEC Contract No W 7405-eng-26; NSE Interspency Agreement AAA-R-4-79. NSF Interagency Agreement AAA-R-4-79.

Descriptors: Water pollution sources, Water pollution effects, Industrial wastes, Environment, Ecology, Social aspects, Toxicity, Lethal limit, Path of pollutants, Standards, Aquatic environment, Metals, Heavy metals. Identifiers: \*Mercury, Methylmercury, Alkylmer-

This is a review of the uses, sources, distribution, and toxic effects of mercury, and the main emphasis is on man as the distributor and recipient of mercury in the environment. There is a need to pay more attention to the social implications of present use practices and to recycle much more effectively or develop alternatives to present mercury technology. The principal man-made sources of environmental mercury in the U.S. are chlor-alkali plants, smelting operations, and probably the burning of fossil fuels, wheras the principal natural sources are the land mass itself and geothermal processes. Data for 'background' and 'contaminated' situations in air, water, rocks, soils, sediments, sludges, fossil fuels, plants, animals, foods, and man are drawn together and briefly evaluated.
Mercury, in whatever form, is potentially exchangeable among the air, land, and water phases, and it is essentially indestructible. Abnormal' concentrations of mercury in terrestrial animals appear concomitantly with the introduction of alkylmercury seed dressings in agriculture during the 1940's, but that mercury levels in fish have steadily risen ever the past 100 years in parallel with increased industrial activity. Only the highly toxic methylmercury form is found in the flesh of fish. The formation of methylmercury appears to be promoted by bacterial processes occuring within contaminated bottom sediments, and such sediments can slowly release their mercury burden as methylmercury for many years to come Alkylmercurials primarily affect neurological processes because of their ability to cross the blood-brain barrier, and they appear to be several orders of magnitude more toxic than other mercury compounds. Mercury vapor is intermediate between the alkylmercurials and other mercury compounds in its effects. Pronounced toxicity is due to lengthy retention by the body. No effective antidote is presently available for these compounds. The criteria for mercury levels are based almost entirely on relatively short-term effects. Tentative standards and guidelines have been set by several organizations and U.S. Government agencies for mercury in air, drinking water, and food. Appendices are included which consider aspects of the physical and chemical properties of mercury. W71-08515

#### SEA-WATER INTRUSION: BOLSA-SUNSET AREA, ORANGE COUNTY, California Dept. State of Water Resources, Sacra-

John R. Cummings, and Chester A. Carville. California Department of Water Resources Bulletin No 63-2, Jan 1968. 167 p, 14 fig, 14 plate, 16

Descriptors: \*Saline water intrusion, \*Aquifers, \*California, Groundwater movement, Path of pollutants, Withdrawal, Chlorides, Salinity, Sea water, Connate water, Aquicludes, Faults (Geology), Hydrogeology, Recharge. Identifiers: \*Orange County (Calif).

The Bolsa-Sunset area, a 6.8-mile-long strip of alluvial-tidal flats and low structural hills and mesas, comprises 55% of the Pacific shoreline of the 330square-mile coastal plain of Orange County, California. Fresh confined groundwaters contain-ing less than 50 ppm chloride occur in moderately to highly permeable early Recent, Pleistocene, and upper Pliocene sand and gravel aquifers landward of the active Newport-Inglewood fault. The fault, located 3,000 to 5,500 feet inland from and approximately parallel to the coast, forms a variable watertight hydraulic barrier across the area, except in late Recent deposits. Pumping of fresh groundwater in excess of recharge caused a 1945-57 decline of inland piezometric levels to elevations of 30 and 50 feet below sea level in the upper aquifers and in the Main aquifer, respectively. Inland and downward head differentials caused intrusion of saline groundwaters through permeable portions of

the fault barrier and through discontinuities in the upper aquiclude. Artificial recharge to the basin forebay and a partial reduction in pumping caused a recovery of piezometric levels during 1959-65. Freshwater heads reached sea level in late 1964 and seasonal artesian flow has existed since. Ion concentrations of groundwaters degraded by sea water intrusion, oil field brines and semiperched water have decreased from peak limits reached in 1961-62. Intrusion and brine wedges have retreated or have become stabilized. (Knapp-USGS) W71-08527

### SYMPOSIUM ON MULTIPLE-SOURCE URBAN DIFFUSION MODELS.

Arthur C. Stern, editor. For sale by the Superinten-Arthur C. Stern, editor. For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC, 20402, Price \$1.75. Proceedings of Symposium on Multiple-Source Urban Diffusion Models, Oct 27-30, 1969, North Carolina University: US Environmental Protection Agency, Air Pollution Control Office Publication No AP-86, 1970. 401 p.

Descriptors: \*Air pollution, \*Cities, \*Atmosphere, Pestriptors: Air poliution, "Cities, "Atmosphere, "Path of pollutants, "Diffusion, Air-earth interfaces, Meteorology, Air circulation, Mass, Energy Vapor pressure, Pollutants, Model studies, Equations, Advection, Convection, Tracers, Synoptic analysis, Reviews.
Identifiers: \*Symposium (Air pollution).

This symposium concerning air pollution in urban surroundings was conducted by the Meteorology Division of the National Air Pollution Control Administration (NAPCA) and the Department of Environmental Sciences and Engineering, School of Public Health, University of North Carolina at Chapel Hill (UNC), Oct. 27-30, 1969. The papers presented during the symposium are contained in this volume and include (1) Diffusion Modeling for Urban Air Pollution Abatement and Control; (2) Physical and Meteorological Basis for Mathematical Models of Urban Diffusion Processes; (3) Prediction of Diffusion over an Urban-Area--Current Practice and Future Prospects; (4) Some Miscellaneous Aspects of Current Urban Pollution Models; (5) Development of a Practical, Multi-purpose Urban Diffusion Model for Carbon Monoxide; (6) An Urban Atmospheric Dispersion Model, (7) Sensitivities of Air Quality Prediction to Input Errors and Uncertainties; (8) Elevation of Tracer Cloud over an Urban Area; (9) Numerical Simulation of the Temporal and Spatial Distributions of Urban Air Pollution Concentration; (10) A Model of Diffusion in Urban Atmospheres: SO2 in Greater New York; and (11) Analysis of Multiple-Station Urban Air Sampling Data. (Woodard-USGS) W71-08533

#### THE PROTECTION OF GROUNDWATER RESOURCES.

For primary bibliographic entry see Field 04B.

#### RECOGNITION OF BUNKER OILS BY THIN-LAYER CHROMATOGRAPHY, Fisheries Research Board of Canada, Halifax

(Nova Scotia).

For primary bibliographic entry see Field 05A. W71-08608

#### MERCURY CONTENT OF VARIOUS BOTTOM SEDIMENTS, SEWAGE TREATMENT PLANT EFFLUENTS AND WATER SUPPLIES IN WISCONSIN (A PRELIMINARY REPORT),

Wisconsin Dept. of Natural Resources, Madison. John G. Konrad.

Research Report 74, 1971. 16 p, 7 fig, 10 tab, 7 ref.

Descriptors: \*Heavy metals, \*Water pollution sources, \*Sediments, \*Stream pollution, \*Hydrogen ion concentration, \*Pulp wastes,

#### **Group 5B—Sources of Pollution**

\*Chemical wastes, Wisconsin, Effluents, Sewage effluents, Industrial wastes, Waste water disposal, Water pollution, Environmental sanitation, Imwater pollution, Environmental sanitation, in-paired water quality, Path of pollutants, Public health, Pollution abatement, Water pollution ef-fects, Wisconsin. Identifiers: \*Mercury pollution, Mercury.

Samples were taken from 168 locations in 30 river and stream systems of Wisconsin, and were analyzed by atomic absorption spectrometry. All bottom sediments were found to contain background mercury concentrations of less than 0.01 to 0.35 ppm, depending on the texture of the 0.01 to 0.35 ppm, depending on the texture of the sediment. High mercury deposits were found below the discharges of the Wyandotte Chemicals Company at Port Edwards on the Wisconsin River and below several pulp and paper mills on the Wisconsin, Chippewa, Flambeau, Wolf, Menominee and Fox Rivers. Accumulations in fish were found to occur where the pH of the water was below 7.5. occur where the pH of the water was below 7.5. Significant amounts of mercury were found below several sewage treatment plants which accept mercury-containing wastes. All public surface water supplies sampled contained less than 0.2 ppb mercury. (LeGore-Washington) W71-08609

LEVELS III IN FISH FROM MERCURY WATERS SELECTED PRELIMINARY REPORT),

Wisconsin Dept. of Natural Resources, Madison. For primary bibliographic entry see Field 05C. W71-08610

FALLOUT PROGRAM QUARTERLY SUMMARY REPORT (DEC. 1, 1970 TO MARCH 1,

1971), New York Operations Office (AEC), N.Y. Health

and Safety Lab.
For primary bibliographic entry see Field 05C.
W71-08649

#### RADIOCARBON IN THE SEA,

Washington Univ., Seattle. For primary bibliographic entry see Field 05A. W71-08650

GROUND WATER SAFETY EVALUATION -PROJECT GASBUGGY,

Teledyne Isotopes, Polo Alto, Calif. Palo Alto

For primary bibliographic entry see Field 05G. W71-08652

PHYSICAL AND BIOLOGICAL EFFECTS: MIL-ROW EVENT. CHAPTER 4: RADIOACTIVITY, Nevada Operations Office (AEC), Los Vegas.

M. L. Merritt. Available from NTIS NVO-79, NVO-79, p 41-8.

Descriptors: \*Nuclear explosions, \*Water pollution, \*Tritium, Groundwater movement, Surface waters, Surface-groundwater relationships, Alaska.

After more than a year, no release of radioactivity from Milrow has been detected. The activity formed remains near the explosion point at 4,000 ft depth. Predictions are made that when the chimmey fills with ground water and normal ground water flow patterns are resumed, the flow will be so slow that the tritium concentrations will be reduced below the Radiation Concentration Guide for drinking water for the general public before the tritiated water reaches the ocean. Methods used to measure the release of radioactivity from both Long Shot and Milrow Events on Amehitka Island, Alaska are discussed. (Bopp-ORNL) W71-08653

THE SANITATION SITUATION OF THE MARINE COASTAL WATERS OF NORTH SAR-DINIA IN RELATION TO INDUSTRIAL POLLU-

TION AND URBAN SEWAGE, (SITUAZIONE IGIENCIA DELLE A CQUE MARINE
COSTIERE DEL NORD-SARDEGNA IN RAPPORTO ALL' INGUINAMENTO INDUSTRIALE
E FOGNARIO-URBANO),

Sassari Univ. (Italy). Instituto di Igiena. G. Bo, U. Alamanni, A. Maida, E. Bianchi, and S.

Revue Internationale d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Institut National de la Sante et de la Recherche Medicale, Foundation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 245-

Descriptors: \*Coasts, \*Pollutant identification, \*Pulp and paper industry, \*Oil wastes, \*Chemical wastes, \*Domestic wastes, Sewage, Industrial wastes, Water pollution sources.
Identifiers: \*Sardinia, \*Italy, Alghero, Portotorres,

Olbia, Arbatax.

Results of research carried out over the past two years in the coastal waters of North Sardinia (Alghero, Portotorres, Olbia, and Arbatax) is reported. A certain degree of pollution was caused by domestic sewage, a considerable degree by papermill wastes and a very modest degree by petrol-chemical industries at Portotorres. (Ensign-PAI) W71-08723

HYGIENIC SITUATION OF SARDINIAN COASTAL WATERS, Cagliari Univ. (Italy). Instituto di Igiena.

Lorenzo Ciogli.

Revue Internationale d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Occanographie Medicale, Institut National de la Sante et de la Recherche Medicale, Foundation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 235-243. 11 ref.

Descriptors: \*Coasts, \*Water pollution control, Preservation, Industrial wastes, Domestic wastes, Public health, Pollutant identification, Water pollution sources, Waste disposal. Identifiers: \*Sardinia, \*Italy.

Investigations carried out during the period of 1959-1969 indicated that the hygienic state of the Sardinia coastal waters is generally good if not excellent. The contaminated areas are limited and the degree of pollution is slight and generally due to domestic waste. Careful re-examination of disposal methods could remedy much of the trouble, par-ticularly the aesthetic aspect which is so important to tourist localities. Industrial pollution appears to be more difficult to eliminate and is apt to become more serious. Strict control is necessary in order to preserve the purity of the Sardinian coastal waters, which is still one of the island's most beautiful attractions. (Ensign-PAI) W71-08724

INVESTIGATIONS ON THE STATE OF POLLUTION OF THE COASTAL WATERS OF THE ITALIAN PENINSULA, (ENQUETES SUR L'ETAT DE POLLUTION DES EAUX COTIERES DE LA PENINSULE ITALIENNE), Bologna Univ. (Italy). Instituto Igiena.

P. Ambrosioni, P. Bisbini, and M. Marinelli.

Revue Internationale d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Institut National de la Sante et de la Recherche Medicale, Foundation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 225-

Descriptors: \*Coasts, \*Water pollution control, \*Pollutant identification, \*Industrial wastes, \*Municipal wastes, \*Water treatment, Treatment facilities, Human population, Waste water disposal, Water pollution sources. Identifiers: \*Italy.

To approximate the pollution situation of the entire Italian seaboard, doctors, scientists, directors of

chemical laboratories and sanitation officers of the coastal areas of Italy were consulted. Local sewage purification, the existence of treatment ponds, the presence of industrial pollution, the scope of the polluted areas along the shore and from shore toward high sea, and the eventual disadvantages caused by actual conditions were considered. Contributing to the situation are ten million inhabitants or 1/5th of the population living along the Italian coast in 300 dwelling centers. Eleven percent of urban agglomerations were found to purify their urban agglomerations were found to purify their waste waters before disposal. This occurred not only in small centers, but in large cities like Genes (880,000) Bari (316,800), Triest (272,000), Reggio-Calabria and others. In some cases waste waters are disposed without any treatment into small streams a few kilometers from the sea. This is small streams a few kilometers from the sea. This is true of Rome, where sewage is discharged in the Tibre. Forty-six percent of the coastal areas are exposed to industrial pollution. Thirty-two percent of these outfalls support some purification treatment of which seventy-five percent are revealed to be very unsatisfactory. (Ensign-PAI) W71-08725

VIABILITY OF ENTAMOEBA HISTOLYTICA CYSTS EXPOSED TO SEA WATER, Technion - Israel Inst. of Tech., Haifa (Israel).

Sanitary Engineering Labs. Hanna Kott, and Yehuda Kott.

Revue Internationale d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Institut National de la Sante et de la Recherche Medicale, Fondation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 85-95.

Descriptors: \*Sewage disposal, Outlets, \*Bacteria, \*Coliforms, Viability, Public health, Urbanization, Water pollution sources, Water treatment. Identifiers: \*Entamoeba histolytica, Cysts.

Scientific, engineering and economic aspects must be taken into consideration for solutions to problems created by urbanization. The theoretical potential hazard of Entamoeba histolytica cysts carried in sewage drift to beaches in which people swim is evaluated. Samples were taken from waste water coming to the municipal sewage treatment plant and Entamoeba histolytica cysts abundance was determined by flotation tests. Influent samples showed a mean of 42/10 liter cysts to a mean of 7/10 liter cysts in effluent samples. Survival studies were also carried out on these cysts and comparisons made in seawater without raw sewage and in the natural marine environment near an outfall. (Ensign-PAI) W71-08735

DISTRIBUTION OF SOME PARASITIC GERMS AND PATHOGENIC BACTERIA IN WORLD-WIDE WATERS, (DISTRIBUTION DES GERMES PARASITES DES BACTERIES PATHOGENES DANS LES EAUX MONDIALES), Institut Pasteur, Paris (France); Murmanskaya Biologicheskaya Stantsiya (USSR); and Akademiya Nauk SSSR, Leningrad. Zoologicheskii Institut

A. Guelin, I. Bychovskaja, P. Lepine, and D. Lamblin

Revue Internationale d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Institut National de la Sante et de la Recherche Medicale, Fondation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 77-83.

Descriptors: \*Self purification, \*Bacteria, \*Pathogenic bacteria, \*Animal parasites, Microorganisms, Equilibrium, Water pollution sources, Water purification.

Bacterial antagonism or the struggle between species of microorganisms in polluted water contributes to the biological purification of water. The distruction of pathogenic bacteria by some parasitic germs is not only a laboratory

#### Sources of Pollution—Group 5B

phenomenon but has occurred in coastal waters of all the continents of the world. Parasitic activity against other bacteria occurs in a wide range of temperatures. Some parasites can survive in water like autotrophs, without additional nutrients until the host bacteria allows their development as parasites. The parasitic germs are needed for the micropopulation equilibrium in the sea. (Ensign-W71-08736

#### FURTHER CONTRIBUTIONS TO THE STUDY THE BIOPRODUCTIVITY IN POLLUTED MARINE ECOSYSTEMS,

Mediterranean Marine Sorting Center, Salammbo (Tunisia).

For primary bibliographic entry see Field 05C. W71-08739

#### THE POLLUTION OF THE COASTAL OCEAN AND THE GREAT LAKES.

M. Grant Gross.

United States Naval Institute. Proceedings, Vol 97. No 819, p 228-243, May 1971. 2 tab.

Descriptors: \*Coasts, \*Great Lakes, \*Water pollution sources, \*Water pollution effects, Water management, Waste disposal.

An assessment is made of waste disposal and water pollution problems as they apply to the coastal ocean and the Great Lakes. The coastal ocean is easily polluted because it is shallow, has a complex coastline geography which restricts water circulation, has coastal currents parallel to the coastline which prohibits mixing, and has an estuarine-like circulation system which prevents little outflow into the open ocean. Sources of coastal water pollution are described, followed by a history of waste pollution problems and sources of wastes in the US Primary and secondary sewage waste treatment are explained. The problem of dredged wastes are ex-plored. Waste disposal effects on the great lakes are also of great concern and can be categorized as: (1) pollution of inshore areas, harbors and tributaries; (2) long-term changes in open water; and (3) long-term changes in sediments. New technology and waste management programs are needed for measuring wastes, restraining further dumping, and preventing further pollution and environmental deterioration of coastal and Great Lakes water. (McEntyre-PAI) W71-08752

#### OCEAN POLLUTION AND MARINE WASTE DISPOSAL

Chemical Engineering, Vol 78, No 3, p 60-67, Feb 8, 1971. 2 fig, 3 tab, 10 ref.

Descriptors: \*Estuaries, \*Water pollution sources, Water pollution effects, Water quality, Waste treatment, Waste disposal. Identifiers: Ocean dumping.

The final resting place of almost all pollutants is the world ocean. An overall examination of the various practices, problems, and constraints on marine disposal is presented. The bulk of marine pollution involves the edges of the sea, with some 39 estuarine systems identified by the Federal Government as having degraded water quality. Marine animals have not had to develop protective systems against intense environmental changes such as those caused by pollution, with the result that only a few fauna can survive. The marine pollutant categories discussed are: salinity; pH; temperature; dissolved oxygen; petroleum products; turbidity and color; settleable solids; floating materials; tainting substances; nutrients; nuisance organisms; and toxic substances. A table is given showing in-dustrial waste discharges, treated and untreated, in coastal states. Five recommendations and a table of factors are given to be considered in designing a disposal system to control process-plant pollution. Legal and legislative aspects of the control of ocean dumping are reviewed. (McEntyre-PAI) W71-08761

MARINE POLLUTION AND FISHERIES. For primary bibliographic entry see Field 05G. W71-08765

#### PESTICIDES AND PLO BIPHENYLS IN ESTUARIES, PLOYCHLORINATED

Bureau of Commercial Fisheries, Gulf Breeze, Fla. Center for Estuarine and Menhaden Research. For primary bibliographic entry see Field 05C. W71-08772

#### NATURAL OF BACKGROUND, OIL SEEPS: HISTORICAL

University of Southern California, Los Angeles. Allan Hancock Foundation. For primary bibliographic entry see Field 05C. W71-08777

# FECAL CONTAMINATION OF FRUITS AND VEGETABLES DURING CULTIVATION AND PROCESSING FOR MARKET, A REVIEW, Environmental Protection Agency, Cincinnati, Ohio. Div. of Water Hygiene. For primary bibliographic entry see Field 05A. W71-08826

#### PULP MILL OUTFALL ANALYSIS BY REMOTE SENSING TECHNIQUES, Oregon State Univ., Corvallis. Dept. of Civil En-

gineering. Wesley P. James, and Fred J. Burgess.

Journal of the Technical Association of the Pulp and Paper Industry, Vol 54, No 3, March 1971, p 414-418. 6 fig, 2 tab, 6 ref. EPA-WQO Program 16070 ENS.

Descriptors: \*Waste water disposal, \*Remote sensing, \*Aerial photography, \*Pulp and paper industry, Industrial waste, Sewage effluents, Oceans, Coasts, Outlets, Mixing, Diffusion, Currents (Water), Water pollution sources, Pollutant identification

A remote sensing system involving aerial photography was utilized to estimate waste concentrations, water currents, and diffusion coefficients in ocean outfall plumes. Acrial photography of the waste field was taken with a multispectral camera system while boat sampling was conducted to provide 'ground truth' data. Data have been compiled and analyzed by a computerized procedure to relate water quality to photographic imagery. The photographic technique is more comprehensive than conventional boat sampling and permits waste concentrations to be measured throughout the plume in one instant. Discrepancies between con-centrations determined by boat sampling and con-centrations determined photographically appear to be due primarily to changing and shifting of the waste in this dynamic environment. (See also W71-08830 thru W71-08832) (James - Oregon State) W71-08829

#### AN AERIAL PHOTOGRAPHIC STUDY OF WASTE FIELD FROM THREE OCEAN OUT-FALLS.

Oregon State Univ., Corvallis. Dept. of Civil Engineering. Wesley P. James, Fred J. Burgess, and Don

Baumgartner.

Offshore Technology Conference Proceedings, Houston, Texas April 19-21, 1971., Paper No OTC 1374, p 1483-1498. 17 fig, 4 ref. EPA-WQO Pro-gram 16070 ENS.

Descriptors: \*Waste water disposal, \*Remote sensing, \*Aerial photography, \*Pulp and paper industry, Industrial waste, Sewage effluents, Oceans, Coasts, Outlets, Mixing, Diffusion, Currents (Water), Water pollution sources, Pollutant identification.

Aerial photography is an effective tool in the study of ocean outfall waste disposal sites. Field studies were conducted on waste plumes from two outfalls

in Oregon and one in northern California. Water currents, waste concentrations and diffusion coefficients were determined from the aerial photography. When the hydrography of the receiving water allowed the formation of a surface plume, the water current velocity was found to be the dominant factor in the resulting plume pattern. The steady state form of the Fickian diffusion equation with a unidirectional transport velocity was not applicable to the majority of the observations. (See also W71-08829) (James-Oregon State) W71-08831

## THE USE OF PHOTOGRAMMETRY IN PREDICTING OUTFALL DIFFUSION, Oregon State Univ., Corvallis. Dept. of Civil En-

Wesley P. James, and Fred J. Burgess.
National Council of the Paper Industry for Air and Stream Improvement, Technical Bulletin No 231, December 1969. 26 p, 14 fig, 1 tab. EPA-WQO Program 16070 ENS.

Descriptors: \*Waste water disposal, \*Remote sensing, \*Aerial photography, \*Pulp and paper industry, Industrial waste, Sewage effluents, Oceans, Coasts, Outlets, Mixing, Diffusion, Currents (Water), Water pollution sources, Pollutant

Ocean outfalls are in general located in the relatively shallow coastal shelf. In this near-shore area sampling from a boat is impossible much of the time and dangerous at all times. As a result, conventional field study methods can only be used during a short period of the year. Aerial photography overcomes many of these difficulties and offers a possible method for studying dispersion of the waste from existing outfalls or evaluating possible locations for proposed outfalls throughout the year in any sea condition. Photographic techniques also provide a more comprehensive and detailed survey than the conventional procedures. Data collected in a fraction of a second with aerial photography would often require several days of continuous boat sampling. As the tide, wind and currents are continuously changing in outfall area, a survey conducted over an extended period of time does not represent the waste field at any instant but is only a composite of the various plume patterns during that period. (See also W71-08829) (James-Oregon State) W71-08832

#### WATER QUALITY MODELLING WITH SUB-MERSIBLE RECORDING WATER QUALITY AND CURRENT METERS,

Ontario Water Resources Commission, Toronto. Water Quality Surveys Branch. For primary bibliographic entry see Field 05A. W71-08887

## MOVEMENT AND RECOVERY OF HERBI-CIDES IN THE OGALLALA AQUIFER,

Agricultural Research Service, Bushland, Tex. Soil and Water Conservation Research Div.
Arland D. Schneider, Allen F. Wiese, and Ordie R.

Jone:

In: The Ogallala Aquifer--A Symposium, Texas The Oganha Adulta-N Symposium, Tech Tech University, Lubbock, International Center for Arid and Semi-Arid Land Studies Special Report No 39, p 219-226, 1970, 8 p, 1 fig, 3 tab, 4 ref.

Descriptors: \*Path of pollutants, \*Groundwater movement, \*Injection wells, \*Pesticides, Pesticide kinetics, DDT, Coliforms, Permeability, Pesticide removal, Absorption, Herbicides, Insecticides, Water pollution effects. Identifiers: \*Ogallala aquifer (Tex).

During the fall of 1969, water from an irrigation well was used to inject three common herbicides into a dual-purpose well in the Ogallala aquifer at the USDA Southwestern Great Plains Research Center, Bushland, Texas. Then, the well was pumped long enough to recover essentially all of

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the recharged water. The dual-purpose well was recharged for 10 days at an average rate of 360 gpm. The herbicides, picloram, atrazine, and trifluralin, were continuously mixed with the recharge water at concentrations that averaged 0.125, 1.28 and 0.24 ppm, respectively. Nitrate, added in the form of sodium nitrate, was used to trace the movement of the recharged water. Water samples pumped from the observation wells at radial distances of 30 and 66 feet from the dual-purpose well showed that all three herbicides moved through the aquifer with the recharged water. The coliform bacteria and DDT were effectively filtered or absorbed by the fine Ogallala sand. (See also W71-08349 thru W71-08357 and W71-08570 thru W71-08575) (Knapp-USGS)

HYDROLOGIC EFFECTS OF STRIP MINING WEST OF APPALACHIA,

Geological Survey, Arlington, Va. For primary bibliographic entry see Field 05C.

UTILITY OF RADIOISOTOPE METHODOLO-GY IN ESTUARY POLLUTION CONTROL STU-DIES--PART 1: EVALUATION OF THE USE OF RADIOISOTOPES AND FLUORESCENT DYES FOR DETERMINING LONGITUDINAL DISPER-SION COEFFICIENT IN ESTUARIES, Quirk, Lawler and Matusky Engineers, New York.
Quirk, Lawler and Matusky Engineers, New York. For primary bibliographic entry see Field 05G. W71-08928

REAERATION IN OPEN-CHANNEL FLOW, Geological Survey, Fort Collins, Colo. For primary bibliographic entry see Field 08B. W71-08936

#### 5C. Effects of Pollution

HYDROBIOLOGICAL CHARACTERISTICS OF SHARK RIVER ESTUARY, EVERGLADES NATIONAL PARK, FLORIDA,

Geological Survey, Tallahassec, Fla For primary bibliographic entry see Field 02L. W71-08329

SPARTINA 'DIE-BACK' IN LOUISIANA MARSHLANDS,

Louisiana State Univ., Baton Rouge. Coastal Studies Inst.

W. G. Smith.

Also published as Louisiana State Univ. Coastal Studies Inst. Technical Report no 91, Dec 1970. Louisiana State University Coastal Studies Bulletin no 5, p 89-96, Feb 1970. 8 p, 2 fig, 13 ref.Contract Nonr 1575 (03), Project ONR, Geog. Progm. Con-tract GH-47 NSF, Office of Sea Grant Programs.

Descriptors: \*Marsh plants, \*Tidal marshes, \*Soilwater-plant relationships, \*Plant pathology, \*Louisiana, Saline water, Plant diseases, Tidal waters, Water pollution effects, Hydrogen sulfide, Drainage, Saturated soils. Identifiers: \*Spartina.

'Die-back' is a term applied to degeneration and death of large areas of Spartina townsendii marshes in England. What appears to be the same condition affects S. alternissora marshes in Louisiana and possibly elsewhere in North America, Several factors that are likely to be involved include (1) excess salinity, (2) pathogenic organisms, (3) lack of available iron, (4) hydrogen sulfide toxicity, (5) change of tidal regime, and (6) pollution. (Woodard-USGS) W71-08348

RESPIRATION OF AQUATIC MACROPHYTES IN EUTROPHIC ECOSTEMS,

Pennsylvania State Univ., University Parks. Dept. of Civil Engineering.
Archie J. McDonnell, and Dennis W. Weeter.

Available from the National Technical tion Service as PB-199 646, \$3.00 in paper copy, \$0.95 in microfich. Completion Report, Institute for Research on Land and Water Resources University Parks, Pa, Apr 1971, 74 p, 15 fig, 18 tab, 46 ref. OWRR Project B-016-PA (2).

Descriptors: \*Eutrophication, \*Aquatic plants, Oxygen, Productivity, \*Respiration, Temperature, Nutrients, Dissolved oxygen, \*Primary productivi-

ty. Identifiers: Potamogeton crispus, Elodea Canadensis, Respirometers.

Extensive laboratory studies were conducted to evaluate on a seasonal basis the respiratory response of selected aquatic plants to changes in oxygen concentration, temperature, and exogenous nutrient additions. Sampling sites included (1) a nutrient rich stream section which received the effluent from a secondary sewage treatment plant and (2) an unenriched section supported solely by watershed drainage. Test species for the study, which was run in continuous flow and batch type respirometers, included the aquatic macrophytes Potamogeton crispus and Elodea canadensis. Consumption rates were found to be dependent on temperature, state of plant maturity, the oxygen con-centration of the test water, and the level of en-richment at the growth site. Values of plant respiration rate at zero dissolved oxygen were observed to vary from 0.21 to 0.87 mg gm to the minus 1 power hr to the minus 1 power with corresponding values of respiration reactivity coefficient ranging from 0.04 to 0.09 lgm to the minus 1 power hr to the minus 1 power. Consumption rates varied from 0.2 to 2.8 mg Osub 2/gm dry weight/hr for dissolved oxygen concentrations of 0 to 18 mg/l. A methodology is presented to estimate primary productivity in aquatic ecosystems from observations of the diurnal variation of dissolved oxygen incorporating a variable community respiration W71-08394

NITROGEN IN AGRICULTURE: THE PROBLEMS AND THE EFFECT ON THE EN-VIRONMENT,

Edinburgh Univ. (Scotland). For primary bibliographic entry see Field 03F. W71-08478

THE LIMNOLOGY OF HYPEREUTROPHIC LAKE BUTTE DES MORTS, WISCONSIN, Wisconsin State Univ., Oshosh. Dept. of Biology; and Wisconsin Univ., Madison. Water Resources

William E. Sloey.

Reprint, Proceedings 13th Conference, Great Lakes Research, 1970, 951-968, International Association Great Lakes Research, 1970, 18 p, 11 fig, 50 ref. OWRR Project A-011-WIS (3).

Descriptors: \*Eutrophication, \*Productivity, \*Nutrients, \*Lakes, \*Phytoplankton, \*Influent streams, Dissolved oxygen, Stratification, Limnolo-

gy, Wisconsin.
Identificers: \*Hypereutrophic, \*Winnebago pool,
\*Shallow reservoir, Nitrate, Phosphate, Melosira
granulata, M. Ambigua, Stephanodiscus Hantschii,
S. niagarae, \*Lake Butte des Morts (Wisc).

Lake Butte des Morts is the mixing basin of the Fox and Wolf Rivers which together comprise the principle influent to Green Bay. The lake is a portion of the larger Winnebago Pool. The water is highly eutrophic-during 1967-68, C-14 productivity of the phytoplankton ranged to 5.2gC/sq m/day and averaged 1227 mgC/sq m/day during the ice-free period. The euphotic zone was only 1.11-1.40 m. Dissolved oxygen decreased to under 3 mg/l in less than 24 hours during temporary stratification.

Nitrate ranged to 2.21 mg/l and phosphate to 0.39 mg/l. Suspended solids averaged 25-50 g/m3 during open water and phytoplankton volumes ranged to open water and phytoplankton volumes ranged to 110,000,000 cu microns/ml. The predominant phytoplankton were Melosira granulata, M. ambigua, Stephanodiscus Hantschii, S. niagarae, and typical nuisance blue-greens. The lake is presently undergoing a loss of littoral vegetation and should be considered hypereutrophic on the basis of phytoplankton production. W71-08494

LAKE AND RIVER POLLUTION, AN ANNOTATED BIBLIOGRAPHY,

For primary bibliographic entry see Field 05B.

MERCURY IN THE ENVIRONMENT-THE HUMAN ELEMENT, Oak Ridge National Lab., Tenn.

For primary bibliographic entry see Field 05B. W71-08515

MERCURY ANALYSES AND TOXICITY: A

Teledyne Brown Engineering, Huntsville, Ala. Environmental Sciences; and Carnegie-Mellon Univ.,

Pittsburgh, Pa.
Robert A. Baker, and Ming-Dean Luh.
Water and Sewage Works, Vol 118, No 5, p IW/21-IW/29, May 1971. 9 p, 67 ref.

Descriptors: \*Pollutants, \*Heavy metals, \*Bibliographies, \*Environmental effects, \*Water pollution, Air pollution, Reviews, Chemical analysis, Analytical techniques, Path of pollutants, Toxins, Toxicity, Chemical properties, Human pathology, Animal pathology. Identifiers: \*Mercury, Mercury poison, Antidotes.

This review summarizes some of the known toxicological effects of mercurials and examines the various analytical procedures used in its identifica-tion and quantification. Perhaps the most devastat-ing indictment of mercury pollution is its long-time persistence. The irreversible effects on adults and unborn children are an ever-increasing concern to public health specialists around the world. Treatment of mercury poisoning with 0.001 M solution of cystein or glutalhione has produced almost instantaneous relief in selected cases. (Woodard-USGS)

W71-08517

NUTRIENT LIMITING FACTORS IN AN OLIGOTROPHIC SOUTH CAROLINA POND, Savannah River Ecology Lab., Aiken, S.C. J. M. Polisini, Claude E. Boyd, and Bonny Didgeon. Oikos, Vol 21, No 2, p 344-347, 1970. 4 p, 1 fig, 3 tab, 7 ref. USAEC Contract AT (38-1)-310.

Descriptors: \*Oligotropy, \*Ponds, \*Nutrients, Descriptors: \*Oligotropy, \*Ponus, \*Nutrients, \*Bioassay, \*South Carolina, Analytical techniques, Nitrates, Phosphates, Sulfates, Calcium, Rainfall, Sampling, Spectrophotometry, Eutrophication. Identifiers: \*Carbon-14 bioassay, Atomic absorption spectrophotometer.

Several small abandoned farm ponds are located on the U.S. Atomic Energy Commission Savannah River Plant near Aiken, South Carolina. These ponds have not been disturbed by human activity since closure of the reservation in 1952. Nutrient relationships were studied in a small oligotrophic pond. Dissolved nutrient levels were very low and marked seasonal changes in concentrations were not apparent. Rainfall nutrient input was large, but comparatively small quantities of nutrients entered the pond in leaf fall. Light and dark bottle productivity estimates were very low. The carbon-14 bioassay technique revealed that sulfate was the only single nutrient capable of increasing productivity. Combinations of nitrate and phosphate increased productivity as much as nitrate, phosphate, and sulfate. When calcium or potassium was added

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with these anions an additional increase in carbon-14 uptake was observed. (Woodard-USGS) W71-08543

THE PH TOLERANCE OF EMBRYOS AND LARVAE OF THE COOT CLAM, MULINIA LATERALIS (SAY),

Bureau of Commercial Fisheries, Milford, Conn. Biological Lab.

Anthony Calabrese. The Veliger, Vol 13, No 2, p 122-126. 2 fig, 1 tab,

Descriptors: \*Oysters, \*Silting, \*Larval growth stages, Hydrogen sulfide, Spawning, Sea water, \*Hydrogen ion concentration, \*Clams, Mollusks. Identifiers: \*Mulinia lateralis, \*Crassostrea virginica, \*Sulmet (sodium sulfamethazine), \*Emburcia, \*Carabata (Sodium sulfamethazine), \*Emburcia, \*Carabata (Sodium sulfamethazine), \*Emburcia, \*Carabata (Sodium sulfamethazine), \*Emburcia, \*Emburcia, \*Carabata (Sodium sulfamethazine), \*Carabata (Sodium sulfame ryonic development, Survival, Ostrea edulis, Coot clam.

To determine the effect of pH on embryonic development of Mulinia lateralis, fertilized eggs were placed in polypropylene beakers containing filtered, ultraviolet-treated sea water (27 plus or minus 0.50/parts per thousand). In three experiments fertilized eggs were placed in beakers and the pH of duplicate cultures was adjusted with HCl or NaOH to levels ranging from 5.75 to 9.25 at 0.25-unit intervals. Three additional experiments were run to determine the effect of various pH levels on the survival and growth of larvae. Some embryos of Mulinia lateralis developed into normal larvae from pH 6.25 to 8.75, but maximum development was satisfactory only within the range from 7.25 to 8.25, and was highest at 7.75. Some larvae survived from pH 5.75 to 9.00, but survival was satisfactory only within the range from 6.50 to 8.75, and was highest at 7.25 to 7.50. Larvae grew satisfactorily within the pH range from 7.00 to 8.50; pH 7.25 was the optimum for growth. (Costello-Washington) W71-08594

#### A DUAL BEHAVIORAL INTERPRETATION OF A SINGLE ENVIRONMENTAL STIMULUS WITH FRESHWATER MUSSELS,

Northwestern Univ., Evanston, Ill.

Marc J. Imlay.

Annual Reports for 1969 of the American Malacological Union, p 21-22. 7 ref.

Descriptors: \*Mollusks, \*Mussels, \*Vibrations, \*Light, \*Behavior, Clams, Shellfish, Water quality,

Light quality, Habitats.
Identifiers: \*External stimuli, Elliptio sp., Amblema sp., Reaction, Stimuli.

A single stimulus may cause different successive reactions in freshwater mussels. An immediate defensive closing is often followed within an hour by opening, i.e., after danger is diminished. This is especially true when light changes serve as the stimuli, and to a lesser degree when the stimulus is vibration. Two species, Elliptio complanatus and Amblema plicata opened after gentle water change. (LeGore-Washington) W71-08595

#### TRANSFER OF TOXIC ALGAL SUBSTANCES IN MARINE GOOD CHAINS,

Hawaii Univ., Honolulu. Dept. of Botany Maxwell S. Doty, and Gertrudes Aguilar-Santos. Pacific Science, Vol 24, p 351-355, July 1970. 1 fig, 2 tab, 11 ref. USPHS Grant No FD-00101-03, NIH Grant No 5-R01-GM-151-98-03, AEC Contract No AT (04-3)-235.

Descriptors: \*Food webs, \*Food chains, \*Toxicity, \*Algal toxins, \*Chlorophyta, \*Phytotoxins, Ecology, Fish food organisms, Path of pollutants, Bioassay, Toxins, Poisons, Poisonous plants, Coral, Invertebrates, Algae, Marine algae, Algal poisoning, Chromatography, Chemical analysis, Biochemistry, Plant physiology, Biological communities. Identifiers: \*Ciguatera, Caulerpa sp., Caulerpicin, Caulerpin, Palmitic acid, Beta-sitosterol, Thin-layer chromatography.

Alcoholic and ether extracts of obligate herbivores, omnivores and detritus feeders common on Caulerpa or in its communities were sometimes found by thin-layer chromatography to contain varying amounts of caulerpicin, caulerpin, palmitic acid, and beta-sitosterol. Cerithium and soft corals, which may be either omnivorous or carnivorous, on occasion contain caulerpicin. The crustacean detritus feeders did not seem to preserve either caulerpicin or caulerpin. Caulerpicin and caulerpin, which, as produced by Caulerpa are physiologically active and toxic to rats and to mice, are apparently transferred along the food chains and concentrated in at least some herbivores. (LeGore-Washington) W71-08597

#### MARINE FOULING IN POWER STATIONS.

Central Electricity Generating Board, Southampton (England). Marine Biological Lab. For primary bibliographic entry see Field 05D. W71-08598

#### MUSSEL FOULING IN CHLORINATED COOL-ING SYSTEMS,

Central Electricity Generating Board, Southampton (England). Marine Biological Lab. For primary bibliographic entry see Field 05D. W71-08599

## RECOVERY OF SALT MARSH IN BRITTANY SIXTEEN MONTHS AFTER HEAVY POLLU-

Nature Conservancy, Norwich (England). Coastal Ecology Research Station. R. E. Stebbings.

Environmental Pollution, Vol 1, p 163-167, 1970. 3 ref.

Descriptors: \*Oily water, \*Water pollution effects, \*Marshes, \*Coastal marshes, \*Salt marshes, \*Marsh plants, \*Soil gases, Oil, Oil wastes, Surveys, Oil-water interfaces, Vegetation establishment, Plant groupings, On-site investigations, On-site data collections, Soil investigations, Tidal marshes, Intertidal area, Water pollution, Soil contamination effects, Aesthetics, Photosynthetic oxygen, Root development.

Identifiers: \*Oil spills, Chlorosis, Salicornia sp., Beta sp., Spartina sp.

Oil was stranded at Cotes du Nord, Britanny in April, 1967 after drifting at sea for 14-18 days. The long drift period enabled the more volatile fractions to dissipate before stranding. The effects were observed of the oil on two marshes 14 days thereafter, and again 16 months later. Oil was originally deposited 2-5 cm deep over the marshes with frequent deeper pools to 10 cm. It was viscous and stuck thickly to vegetation. Sixteen months later, most salt marsh plant species survived all but the heaviest contamination, with the exceptions of Salicornia perennis and Beta maritina. Oil appeared to prevent gaseous interchange between soil and air, yielding reducing conditions, leading to chlorosis in plants. Vegetative reinvasion occurred in cracks of drying oil layers. Specification of the type oil involved may have rendered the observa-tions more valuable, but crude oil is assumed in the absence of this detail. (LeGore-Washington)

## ACCUMULATION OF DDT RESIDUES IN TRIPHOTURUS MEXICANUS FROM THE GULF OF CALIFORNIA, Stanford Univ., Pacific Grove, Calif. Hopkins

Marine Station. James L. Cox.

Nature. Vol 227, No 5254, p 192-193, July 11, 1970. 1 fig, 1 tab, 11 ref. NSF Grant.

Descriptors: \*DDT, \*Gas chromatography, Descriptors: DDT, Gas Chromasgan, Archiorinated hydrocarbon pesticides, \*Pesticide residues, \*Fish physiology, Water pollution effects, Diffusion, Fish food organisms, Food chains, Path of pollutants.

Identifiers: \*DDE, Triphoturus sp., Concentration, Biological concentration, Fish gills, Gulf of Califor-

In an attempt to obtain size-class data about concentrations of pesticide residues, relatively free of pesticide 'hot spots,' Triphoturus mexicanus, a midwater fish from an area remote from areas of gas chromatography. DDT concentrations ranged from 13 to 79 ppb. The controversy concerning the importance of diffusive loss of pesticide residues across gill membranes is discussed. An increase in total residue and DDE concentrations with fish body weight was found. This evidence tends to minimize the importance of residue loss by diffusion, because no apparent equilibrium is established. (LeGore-Washington)

#### STUDIES ON ACCUMULATION OF HEAVY METALS IN AQUATIC ORGANISMS--IV. ON DISAPPEARANCE OF ABNORMALLY ACCU-MULATED COPPER AND ZINC IN OYSTERS. (IN JAPANESE), Miyazaki Univ., Miyazaki (Japan). Faculty of

Agriculture. Ikuta Kunio.

English summary. Bulletin of the Japanese Society of Scientific Fisheries, Vol 34, No 6, p 482-487, June 1968. 7 fig, 3 tab, 8 ref.

Descriptors: \*Heavy metals, \*Copper, \*Oysters, \*Public health, \*Self-purification, Metals, Water pollution effects, Shellfish, Mollusks, Bioassay, Environmental sanitation, Human diseases. Identifiers: \*Zinc, \*Depuration, Japan.

Oysters containing abnormally high levels of copper and zinc were transplanted to a normal oyster growing area, and depuration of the metals was observed. Excretion of the accumulated Cu does not begin until two weeks or longer after transplantation, while the Zn begins to disappear immediately. Once begun, however, Cu levels decrease at greater than twice the rate that Zn is eliminated. The metal contents of the oysters and the Zn:Cu ratio fell to normal within 116 days. (LeGore-Washington) W71-08603

## DYNAMICS OF ENDRIN UPTAKE AND RELEASE BY RESISTANT AND SUSCEPTIBLE STRAINS OF MOSQUITOFISH, Missispipi State Univ., State College. Dept. of

Denzel E. Ferguson, J. Larry Ludke, and George G. Murphy.

Transactions of the American Fisheries Society, Vol 95, No 4, p 335-344, Oct 1966. 8 tab, 17 ref. PHS Grant No ES 00086-01.

Descriptors: \*Water pollution effects, \*Endrin, \*Pesticide toxicity, \*Chlorinated hydrocarbon pesticides, \*Resistance, Pesticide residues, Absorption, Bioassay, Fish physiology, Mortality, Pollutants, Water pollution sources, Lethal limit, Poisons, Toxins, Toxicity, Fish diseases, Fishkill, Runoff.

Identifiers: \*Mosquitofish, \*Gambusia sp., TL-m, Farm runoff, Cotton fields.

Laboratory bioassays indicated that mosquitofish. Gambusia affinis, from near heavily-treated cotton fields (36 hr TL-m - 1,000 ppb) and from an uncontaminated site (36 hr TL-m — 1 ppb) remove endrin from static test solutions at the same rate. A 500 ppb endrin solution produced 32% mortality in 50 susceptible fish in 25 min, but required 144 hr in resistant fish. About six times as much endrin is taken up via the exposed head region as is taken up by the general body surfaces. Oxygen requirements

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of the two populations are similar, but increase for susceptible fish at low endrin concentrations, and for resistant fish at high concentration coincident with the appearance of symptoms of endrin poisoning. A single resistant female, exposed to 1,000 ppb endrin, released sufficient endrin in 10 liters of water to kill five susceptible fish in 38.5 hr and survived the experience. The mechanism of resistance is physiological toleration of massive endrin accumulations, but is is not known how the toxic effects of endrin are avoided. (LeGore-Washington) W71-08604

#### FISH KILL CAUSED BY AN INTERMEDIATE

OIL FROM COKE OVENS, Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station. V. Zitko, and S. N. Tibbo.

Bulletin of Environmental Contamination and Toxicology, Vol 6, No 1, p 24-25, 1971. 1 ref.

Descriptors: \*Oil, \*Fishkill, \*Mortality, \*Water pollution effects, \*Herrings, \*Lethal limit, \*Fish toxins, \*Toxicity, Oily water, Oil wastes, Fish physiology, Fish diseases, Chromatography, Bioas-

Identifiers: \*Oil pollution, Coke, Coke production.

A mass mortality of herring occurred in North Sydney Harbor, Nova Scotia, Canada in April, 1969. Dead fish were examined, and skin muscle and intestines were found to contain, respectively, 17.5, 5.2 and 9.2 ug of the suspected oil per gram wet weight. Bioassays indicated LT-50 values (time to 50% mortality in hours) of 0.25, 0.87, 3.7 and 93.0 at 100, 10, 8 and 6 ppm of oil, respectively. The detection of the oil in dead herring and the high tox icity of the oil to herring under laboratory conditions indicate that this intermediate oil caused the fish kill. The distribution of the oil in the tissues shows that the oil was taken up primarily through the body surface. (LeGore-Washington)

#### REHABILITATION OF OILED BIRDS IN MAS-

SACHUSETTS, Wildlife Rehabilitation Center, Upton, Mass. Philip B. Stanton.

Marine Pollution Bulletin, Vol 1 (NS), No 9, p 134-135, Sept 1970.

Descriptors: \*Water pollution effects, \*Water pollution treatment, \*Oily water, \*Cleaning, \*Treatment, Bufflehead Duck, Ducks (Wild), Gulls, Waterfowl, Oil wastes, Oil, Detergents, \*Reha-

Identifiers: \*Oil pollution, \*Polycomplex A-11, Eiders, Mergansers, Scoters, Scaup, Gannets,

Polycomplex A-11 is recommended, at 1-2 parts per 100 parts of water, for cleaning oil from birds. The considerations of shelter, drinking water, food, medication, extended care, and ultimate release are discussed. Procedures outlined are not a complete solution to the problems of bird rehabilitation, but considerable success has been enjoyed. (LeGore-Washington) W71-08607

#### RECOGNITION OF BUNKER OILS BY THIN-LAYER CHROMATOGRAPHY,

Fisheries Research Board of Canada, Halifax (Nova Scotia)

For primary bibliographic entry see Field 05A. W71-08608

#### MERCURY CONTENT OF VARIOUS BOTTOM SEDIMENTS, SEWAGE TREATMENT PLANT EFFLUENTS AND WATER SUPPLIES IN WISCONSIN (A PRELIMINARY REPORT), Wisconsin Dept. of Natural Resources, Madison

For primary bibligraphic entry see Field 05B.

FISH F WATERS LEVELS IN WISCONSIN FROM MERCURY

PRELIMINARY REPORT),
Wisconsin Dept. of Natural Resources, Madison.
Stanton J. Kleinert, and Paul E. Degurse.
Research Report 73, 1971. 16 p, 1 fig, 3 tab, 15 ref.

Descriptors: \*Heavy metals, \*Stream pollution, \*Path of pollutants, \*Public health, Wisconsin, Industrial wastes, Environmental sanitation, Water pollutioneffects, Pulp wastes, Chemical wastes, Walleye, Suckers, Catfishes, Sunfishes, Yellow perch, Fish, Fish physiology, Lake Michigan, Lake Superior, Mississippi River.

Identifiers: \*Mercury pollution, \*Bioconcentra-tion, Concentration, Mercury, Redhorse fish, Crap-

pie, Green Bay Wisconsin.

Mercury determinations were made on fish filet samples from throughout Wisconsin and from Wisconsin's boundary waters of Lake Michigan, Green Bay, Lake Superior and the Mississippi River. All Wisconsin fish analyzed contained some mercury, with a range of 0.01 to 0.60 ppm, and an average of 0.19 ppm. The highest mercury levels, averaging 0.80 ppm, and ranging from 0.06 to 4.62 ppm, occurred in fish taken from below paper mills and from below a mercury cell chlor-alkali plant. Different species vary in mercury content, and the larger fish often contain higher concentrations than do smaller fish of the same species taken from the same water. Walleye, sucker, redhorse, crappie and bullhead frequently showed higher mercury concentrations, while the panfishes showed lower concentrations. It is essential, therefore, that mercury levels in all important species in the fishery be determined before the potential pollution problem can be adequately assessed. (LeGore-Washington) W71-08610

## EFFECTS OF ARTIFICIAL DESTRATIFICA-TION ON DISTRIBUTION OF BOTTOM OR-GANISMS IN EL CAPITAN RESERVOIR,

California State Dept. of Fish and Game, Sacramento. Inland Fisheries Branch. For primary bibliographic entry see Field 05G. W71-08611

#### INFLUENCES OF HIGH TEMPERATURE AND RESIDUAL CHLORINE ON THE MARINE PLANKTONIC LARVAE (IN JAPANESE),

Nagasaki Univ., (Japan). Faculty of Fisheries. Kazutsugu Hirayama, and Reijiro Hirano. English summary. Bulletin of the Faculty of Fisherics, Nagasaki University, No 29, p 83-89, Aug 1970. 1 fig, 4 tab, 4 ref.

Descriptors: \*Chlorination, \*Lethal limit, \*Thermal pollution, \*Water pollution effects, \*Larvae, \*Heat resistance, Chlorine, Poisons, Toxicity, Bioassay, Heated water, Water temperature, Water utilization, Oysters, Mortality, Cooling water. Identifiers: TL-m, Crassostrea gigas, Mytilus edulis, Balanus sp., Anthocidaris sp., Sea urchins, Barna-

Some biological effects of brief exposure to high temperature and to dissolved chlorine were determined to simulate the environmental danger presented by use of industrial cooling water. Temperature bioassays were conducted against 2-4 cell, blastula and pluteus stages of the sea urchin (Anthocidaris crassipina), against nauplii of the rock barnacle (Balanus amphitrite albicostatus), and against the blastula stage of the oyster (Crassostrea gigas). Trochophore and 2-4 cell larvae of the mussel, Mytilus edulis, were exposed to the chlorine. Young sea urchin larvae are least tolerant to heat, being unable to survive a 20 min exposure to 33 C. Nauplius II barnacle larvae are most tolerant, surviving a 40 min treatment at 40 C. The 10 min TL-m values for 2-4 cell and for trochphore mussel larvae are 1.15 and 1.31 ppm, chlorine in water, respectively. The 5 min TL-m increased from 1.21 ppm chlorine for 2-4 cell mussels to 2.37 ppm chlorine for trochophore mussel larvae. LeGore-Washington) W71-08613

INFLUENCES OF HIGH TEMPERATURE AND RESIDUAL CHLORINE ON MARINE PHYTOPLANKTON,

Nagasaki Univ., (Japan). Faculty of Fisheries; and Tokyo Univ., (Japan). Faculty of Agriculture. K. Hirayama, and R. Hirano.
Marine Biology, Vol 7, No 3, p 205-213, Nov 1970. 10 fig, 5 tab, 3 ref.

Descriptors: \*Chlorination, \*Lethal limit, \*Ther-Descriptors: \*Chlorination, \*Lethal limit, \*Thermal pollution, \*Water pollution effects, \*Chlamydomonas, \*Heat resistance, Chlorine, Poisons, Toxicity, Bioassay, Heated water, Water temperature, Water utilization, Mortality, Cooling water, Photosynthesis, Primary productivity, Phytoplankton, Inhibition, Resistance.

Identifiers: \*Skeletonema sp., \*Photosynthetic inhibition, Temperature shock, Acute exposure.

The direct influence of high temperature and residual clorine on growth and photosynthesis of Chlamydomonas sp. and Skeletonema costatum were investigated experimentally. Chlamydomonas sp. and S. costatum exposed to high temperatures were affected in their growth from 43 C and 35 C, respectively, by immersion of the respective cultures in a warm bath for 10 min. Exposure to high temperatures of 40 C and 34-35 C for 10 min influenced their photosynthetic activities, which were completely inhibited immediately after 10 min exposure to 42 C and 37 C, respectively. S. costatum was killed by chlorine at a concentration costatum was killed by chlorine at a concentration of 1.5-2.3 ppm when exposed for either 5 or 10 min, while Chlamydomonas sp. was not irreversibly damaged even at 20 ppm chlorine or more with the same exposure period. The high temperature of, and residual chlorine in, effluents from a power plant discharging into the open sea, should not cause great damage to marine phytoplankton in that area. (LeGore-Washington) W71-08615 W71-08615

## CHRONIC TOXICITY, UPTAKE, AND RETENTION OF AROCLOR 1254 IN TWO ESTUARINE FISHES.

Environmental Protection Agency, Gulf Breeze, Fla. Gulf Breeze Lab.

D. J. Hansen, P. R. Parrish, J. I. Lowe, A. J. Wilson, Jr., and P. D. Wilson.

Gulf Breeze Contribution No 120. Bulletin of Environmental Contamination and Toxicology, Vol 6, No 2, p 113-119, 1971. 2 tab, 11 ref.

Descriptors: \*Water pollution effects, \*Pesticide toxicity, \*Bioassay, \*Chlorinated hydrocarbon pesticides, DDT, Mortality, Poisons, Gas chromatography, Lethal limit, Laboratory tests. Identifiers: \*Polychlorinated biphenyls, \*Aroclor 1254, \*Chronic exposure, PCB, Lagodon sp., Leinstermus sp. Longterm bioassay, Pinfich Spectations.

Leiostomus sp., Long-term bioassay, Pinfish, Spot (Fish).

Some effects of the polychlorinated biphenyl (PCB) mixture, Aroclor 1254 (Monsanto Co., St. Louis, Mo.), on the pinfish (Lagodon rhomboides) and the spot (Leiostomus xanthurus) were determined in laboratory bioassay. Previous work indicated that PCB is not acutely toxic to juvenile pinfish. This work indicates, however, that both species of fish died (41-66% mortality) when exposed for 14-45 days to 5 ppb of Aroclor 1254. Spot appeared unaffected by 1.0 ppb for up to 56 days. Chronic exposure to Aroclor 1254 apparently increased susceptibility of test pinfish and spot to disease, and also appeared toxic. This PCB is rapidly stored by these fish, and persists in tissues for about three months. (LeGore-Washington) W71-08616

# POLYCHLORINATED BIPHENYL (AROCLOR 1242): EFFECTS OF UPTAKE ON GROWTH, NUCLETIC ACIDS, AND CHLOROPHYLL OF A MARINE DIATOM, Medical Univ. of South Carolina, Charleston; Preventive Medicine Section; and South Carolina Board of Health, Columbia. Environmental Health

Labs.

Julian E. Keil, Lamar E. Priester, and Samuel H. Sandifer.

#### Effects of Pollution—Group 5C

Bulletin of Environmental Contamination and Toxicology, Vol. 6, No 2, p 156-159, 1971. 1 tab, 8 ref. NIH General Research Support Grant 5420.

Descriptors: \*Water pollution effects, \*Inhibition, \*Phytotoxicity, \*Bioassay, \*Chlorinated hydrocarbon pesticides, Pesticide toxicity, Poisons, Photosynthesis, Diatoms, Chlorophyll, Gas chro-

matography.
Identifiers: \*Polychlorinated biphenyls, \*Aroclor 1242, PCB, Cylindrotheca sp., Plant growth inhibition, RNA synthesis, DNA synthesis, Chlorophyll

Some effects of the polychlorinated biphenyl (PCB) mixture, Aroclor 1242 (Monsanto Co., St. Louis, Mo.), on the metabolism of the marine diatom, Cylindrotheca closterium, were determined in laboratory bioassay. PCB was taken up by the diatoms and concentrated up to 1100 time. the diatoms and concentrated up to 1100 times above levels added to the culture medium. The above levels added to the culture medium. The higher medium level of PCB (0.1 ppm) sharply inhibited growth, as evidenced by harvest weights and cell counts. The 0.1 ppm dosage also significantly reduced RNA synthesis and the chlorophyll index, but apparently had no effect on DNA levels. PCB at 0.01 ppm in the medium did not seem to adversely of the contraction of the con versely affect growth or seriously alter nucleic acid levels or chlorophyll production. (LeGore-Washington) W71-08617

#### A CONSTANT FLOW DELIVERY DEVICE FOR CHRONIC BIOASSAY, Colorado State Univ., Fort Collins. Dept. of

Fishery and Wildlife Biology.

Robert A. Freeman.

Transactions of The American Fisheries Society, Vol 100, No 1, p 135-136, Jan 1971. 2 fig. Federal Water Quality Admin Grant.

Descriptors: \*Bioassay, \*Laboratory equipment, Laboratory tests, Assay, Water pollution effects, Lethal limit, Toxicity. Identifiers: \*Bioassay equipment, \*Dispensing

equipment, Bioassay techniques.

A low cost, mechanically simple device for delivering predetermined amounts of solution over extended periods has been developed for flowthrough bioassay experiments. The device works on the siphoning principle, with a float holding the dispensing end of the siphon at a constant level relative to the surface of the fluid being dispensed. Flow rates greater than 15 ml/min work well, and lower flow rates can be acquired by use of smaller internal diameter tubing than the prescribed 2mm. A 55 gal drum serves as the reservoir, although polyethylene drums have since been found superior (unpublished communication). Because the metering device ceases to function below the 35 liter level, a working volume of about 180 liters is routinely provided. At a 20 ml/min flow rate, this supply lasts more than six days. (LeGore-Washington) W71-08618

## ABSORPTION AND RETENTION OF ORGANIC MERCURIALS BY RAINBOW TROUT AND CHINOOK AND SOCKEYE SALMON, Bureau of Sport Fisheries and Wildlife, Seattle,

Wash. Western Fish Disease Lab.
Robert R. Rucker, and Donald F. Amend.
The Progressive Fish Culturist, Vol 31, No 4, p 197-201, Oct 1969. 6 tab, 1 ref.

Descriptors: \*Rainbow trout, \*Chinook salmon, \*Sockeye salmon, \*Metals, Bioassay, Water pollution effects, Environmental sanitation, Impaired water quality, Path of pollutants, Public health, Fish diseases

Identifiers: \*Mercury pollution, \*Pyridyl mercuric acetate, \*Ethyl mercury phosphate, Bacterial gill diseases, Bioconcentration.

The rate of absorption and excretion and the sites of retention in rainbow trout exposed to ethyl mercury phosphate and pyridyl mercuric acetate were

studied. Young chinook salmon were fed fingerlings that had been bathed in ethyl mercury phosphate. The concentrations of mercury in the gills, blood, liver and kidney of the salmon and sins, blood, liver and kidney of the salmon and trout were determined. The mercurials were absorbed and retained by fish in some tissues for periods up to 28 weeks after exposure. (Katz-Washington) W71-08619

#### POTENTIAL TOXICITY OF KRAFT MILL EF-FLUENT AFTER OCEANIC DISCHARGE,

Oregon State Univ., Corvallis. Engineering Experiment Station; and Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.

Robert C. Courtright, and Carl E. Bond.
The Progressive Fish Culturist, Vol 31, No 4, p 207-212, Oct 1969. 5 fig, 3 tab, 6 ref. FWPCA Grant no WP-524.

Descriptors: Pulp wastes, \*Water pollution effects, \*Toxicity, \*Sculpins, \*Lethal limit, Marine fish, Mussels, Bioassay, Resistance, Pulp and paper industry, Industrial wastes. Identifiers: \*Kraft mill effluents, \*Foam, Fluffy sculpins, TL-m, Median tolerance limits.

Toxicity bioassays were conducted with the marine species, fluffy sculpin, and the larvae of mussels to determine the toxicity of foamed kraft mill effluent. The foamed effluent was five times more toxic than the whole waste before discharge into the salt water. The sculpins can survive in toxic concentrations for a longer period in cool water (16 C) than in warm water (28 C). The 64 hr median tolerance limit (TL-m) at 18 and 30 parts per thousand salinity was about 9% of the kraft mill effluent foam. (Katz-Washington) W71-08620

#### FALLOUT PROGRAM QUARTERLY SUMMA-RY REPORT (DEC. 1, 1970 TO MARCH 1,

1971), New York Operations Office (AEC), N.Y. Health and Safety Lab.

E. P. Hardy. Available from NTIS HASL-242. HASL-242, Apr 1, 1971, 325 p.

Descriptors: \*Bibliographies, \*Data collection, \*Theoretical analysis, \*Radioactivity techniques, Potable water, Carbon radioisotopes, Radioactivity, Milk, Food chains, Strontium, Radioisotopes, Fallout, Atmosphere, Carbon dioxide, Ocean circulation.

Identifiers: Cesium radioisotopes.

The initial section consists of interpretive reports covering natural radioactivity, strontium-90 in bone of three population groups in South Africa, radiocarbon in the sea, fallout of trace metals in New York City, quality of gamma spectral analysis, strongium-90 yield of the Sept. 1969 Chineses nuclear test, and strontium-90 in the New York City and San Francisco diet. Subsequent sections include tabulations of radionuclide levels in surface air, stratospheric air, fallout, milk, other diet components and tap water. (See also W71-08650) (Bopp-ORNL) W71-08649

#### STUDIES OF THE NATURAL ALPHA-EMITTING RADIOISOTOPES IN MARINE OR-GANISMS,

Washington, Univ., Seattle.
Thomas M. Beasley.
Available from NTIS RLO-2225-F-14-1. RLO-2225-T-14-1, Dec 1970. 46 p, 1 fig, 7 tab, 50 ref. AEC Contract AT (45-1)-2225.

Descriptors: \*Radioisotopes, \*Absorption, \*Aquatic population, \*Lead radioisotopes, Zooplankton, Crustacean, Benthic fauna, Bottom fish, Saline water fish, Brackish-water fish, Freshwater fish, Trace elements.

Identifiers: \*Polonium radioisotopes. radioisotopes.

Tissues from organisms (zooplankton, pelagic fishes, and benethic organisms) were analyzed for polonium-210, lead-210, and stable lead. Polonium-210 increased from codepods to euphausiids and from mysids to pelagic fishes, but lead-210 decreased through the same chain. Polonium-210 was lowest in but excitated and Althur and Carlon and Carl was lowest in late spring and summer. Although levels were not considered toxic in fish protein concentrates, ingestion of normal amounts would substantially increase dietary levels of polonium-210, lead-210, cobalt and lead. The increase in uptake would be less important for silver, cadmium, copper, iron, zinc, and manganese. Blood from residents of Rongelap Atoll showed unusually high body burdens of iron-55. (Bopp-ORNL) W71-08654

### TRANSFER OF TRITIUM TO MAN FROM AN INITIAL WET DEPOSITION,

Oak Ridge National Lab., Tenn.
M. J. Kelly, and R. S. Booth.
Available from NTIS ORNL-TM-3134, ORNL-TM-3134, Jan 1971. 22 p, 8 fig, 5 ref. AEC Contract W-7405-eng-26.

Descriptors: \*Tritium, \*Soil contamination effects, \*Nuclear explosions, Rainout, Food and cover crops, Radioactivity effects, Potable water, Rainfall, Soil water movement.

The total dose to man was estimated from a given sequent rainfall which tends to decrease the dose by dispersing the tritium deep into the soil. Except for the desert, the time-dependent concentration of tritium in soil is primarily determined by the rainfall after deposition and is nearly independent of the assumed depth of the soil compartment. A mathematical model was employed which was mathematical model was employed which was tested qualitatively against experimental results. (Bopp-ORNL) W71-08655

ECOLOGY OF ANIMAL COMMUNITIES, Johns Hopkins Univ., Baltimore, Md. School of Hygiene and Public Health. Brenda K. Sladen.

IN: Biology of Populations, The Biological Basis of Public Health, New York, American Elsevier Publishing Co., 1969, p 87-100.

Descriptors: \*Radioecology, \*Aquatic populations, \*Strontium radioisotopes, Productivity, Food webs, Life cycles, Lakes, Cycling nutrients, Energy

Accumulation of radionuclides demonstrated aquatic animal community interrelationships. A Canadian lake contained radionuclides seeping Canadian lake contained radionuclides seeping from a liquid waste disposal area. Biological activity during the warmer months depleted the nuclide levels. Strontium-90 in perch bones reached a constant after 5 years, and after 2 years or less in shorter lived animals. Cycling from species to species was followed. Strontium-90 concentration was 3,000 to 3,500 times greater in perch and muskrat bones than in water. Ecological concepts which are considered include succession, cycling, energy considered include succession, cycling, energy flow, and food webs. (Bopp-ORNL)
W71-08656

## ANNUAL REPORT FOR 1970 TO THE USAEC, DIVISION OF BIOLOGY AND MEDICINE, VOLUME 1 LIFE SCIENCES, PART 2 ECOLOGICAL SCIENCES.

Battelle Memorial Inst., Richland, Wash. Pacific

Available from NTIS BNWL-1550 (Vol) (Pt 2). BNWL-1550, Vol. I, Part 2, Mar 1971. About 110 p. UC-48, Biology and Medicine.

Descriptors: \*Ecology, \*Environmental effects, \*Radioactivity effects, Thermal stress, Nuclear powerplants, Tritium, Zine radioisotopes, Strontium radioisotopes, Cesium, Soils, Predation, Food chains, Columbia River, Deserts, Arctic, Soils,

#### Group 5C-Effects of Pollution

Identifiers: Cesium radioisotopes.

Characterization of functional roles and responses to disturbances of plants and animals is emphasized in the terrestrial program. The ALE Reserve, Alaska, Antartica, and both riparian and dessert communities near Hansford are included in the environments being studied. Determination of effects of man-made stress on aquatic environments is emphasized in the aquatic program. The effects of thermal increments and radiation are delineated and predicted. Base line studies on primary productivity, growth, and rates of transfer of essential elements are important for measurement of the sublethal effects of these stress factors. (See also W71-08658 and W71-08659) (Bopp-ORNL)

ECOLOGIC CHARACTERISTICS OF THE COLUMBIA RIVER. FRESHWATER ECOLOGY OF RATTLESNAKE SPRINGS. RATES AND MECHANISMS OF BIOGEOCHEMICAL PROCESSES OF THE COLUMBIA RIVER, Battelle Memorial Inst., Richland, Wash. Pacific

Battele Michael Labs.
R. E. Wildung, R. L. Schmidt, C. E. Cushing, C. D. Becker, and D. G. Watson.
BNWL-1550, Vol. I, Part 2, Mar 1971, p 2.1-2.10, 2 fig, 3 tab, 9 ref.

Descriptors: \*Suspended load, \*Aquatic productivity, \*Bioassy, \*Radioactivity effects, Zinc radioisotopes, Periphyton, Freshwater fish, Cycling nutrients, Food web, Chemical analysis, Dissolved oxygen, Carbon dioxide, Hydrogen ion concentration, Thermal stress, Columbia River, Biota, Cation description, Mantagrillonite, Illite, Silicates, Princellonite, Illite, Silicates, Illite, Illite, Silicates, Illite, Illite, Illite, Illite, Illite, Illite adsorption, Montmorillonite, Illite, Silicates, Primary productivity.

Transfer rates of radionuclides and stable elements are being investigated in aquatic systems. Several related aspects of primary productivity are being studied, for example, in relation to soil particle-water exchanges, and in relation to plant and animal structure in the ALE Receive ecosystem. An understanding of the interaction between water, suspended materials, and the biota is necessary became the productive for the force for example. sary because thermal stress effects, for example on the periphyton community, can ultimately affect fish. (See also W71-08657) (Bopp-ORNL) W71-08658

FIXATION AND LONG-TERM ACCUMULA-TION OF TRITIUM IN AN EXPERIMENTAL AQUATIC ENVIRONMENT AND EFFECTS OF SHORT RANGE PARTICLE IRRADIATION ON EMBRYOGENESIS OF MARINE TELEOST FISH.

Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.

J. A. Strand, W. L. Templeton, E. G. Tangen, and

P. A. Olson. BNWL-1550, Vol. I, Part 2, Mar 1971, p 2.36-2.40, 2 fig, 1 tab.

Descriptors: \*Tritium, \*Embryonic growth stage, \*Marine fish, Nuclear powerplant, Food web, Aquatic environment, Absorption, Water pollution, Environmental effects, Radioactivity effects, Water pollution effects.

Tritium as tritiated water will be a major contributor to the radioactivity in the effluents from nuclear power plants, and it cannot be removed by conventional technology. Two new research programs were initiated to determine the ultimate concentration in and its effect upon segments of the aquatic ecosystem. Experiments on the aquatic food web have just commenced, in which tritiated water is introduced into an ecosystem at a concentration of 1.0 microCi/l. In the other groups of experiments, preliminary consideration of data indicates no significant degree of detriment in embryogenesis, as resulting from exposure to levels of 0.01, 0.1 and 1.0 microCi/ml of tritium. However the present effort treats only a portion of the early life stages.

Longer term studies will be necessary to investigate the problem fully, to examine first embryonic mitosis (four-cell blastomere stage), and to examine time of reabsorption of yolk sac. (See also W71-08657) (Bopp-ORNL) W71-08659

THE ECOLOGY OF THE SECOND TROPHIC LEVEL IN LAKES SUPERIOR, MICHIGAN AND HURON,

Minnesota Univ., Minneapolis. School of Public Health.

W. R. Swain, T. A. Olson, and T. O. Odlaug. Available from the National Technical Information Service as PB-199 938, \$3.00 in paper copy, \$0.95 in microfiche. Minnesota Water Resources Research Center, Bulletin 26, Oct 1970. 151 p. 95 fig, 43 tab, 85 ref. OWRR Project A-011-MINN (10).

Descriptors: \*Tropic level, \*Lake Superior, \*Lake Michigan, \*Lake Huron, \*Plankton, Ecology, Zooplankton, \*Eutrophication, Organisms, Aquatic environment, Limnology, Vertical migration, Biogeography, Phytoplankton, Crustaceans. Identifiers: \*Continuous plankton recorder, Multidenth plankton indicator, Two-net technique, Gritant Programment (1997). depth plankton indicator, Two-net technique, Grit gauze, Silk bolting cloth.

A series of lake-long transect tows were made with the Continuous Plankton Recorder in Lakes Superior, Michigan and Huron, 1966-68. All tows were made at ten meters depth with either no. 60 mesh Grit Gauze or no. 15 mesh Silk Bolting cloth. Information was obtained on organism distribution in both space and time. The density and distribution of ecologically related groups in plankton indicate the relative tropic status of the bodies of water sampled. Lake Superior is the most oligotrophic, Lake Huron the most eutrophic and Lake Michigan more mesotrophic. A mean of 200 to 300 organisms per section was seen in Lake Superior; a range of 5,000 to 6,000 organisms per section was seen in Lake Michigan and from 20,000 to 21,000 organisms were observed from one year to another and from one season to another. Marked variations in both numbers and species of organisms were evident in the lakes. Limitations of the Continuous Plankton Recorder method are described. (Walton-Minnesota) W71-08665

DETERMINATION OF THE FEASIBILITY OF REMOVAL OF ALGAL NUTRIENTS IN LAKE WATER BY ION EXCHANGE,

Massachusetts Univ., Amherst. Water Resources Research.

For primary bibliographic entry see Field 05G. W71-08669

LAKE MINNETONKA: NUTRIENTS, NUTRIENT ABATEMENT, AND THE PHOTOSYNTHETIC SYSTEM THE PHTOPLANKTON,

Minnesota Univ., Minneapolis. Limnological Research Center. Robert O. Megard.

Available from the National Technical Information Available from the Vadional Technical Information Service as PB-199 915, \$3.00 in paper copy, \$0.95 in microfiche. Final Report, Dec 1970. 210 p. 21 fig, 10 tab, 41 ref, 3 append. OWRR Project A-016-MINN (4).

Descriptors: \*Limnology, \*Lakes, \*Photosynthesis, \*Phytoplankton, \*Productivity, Algae, Nitrogen, Phosphorus, Mathematical models, Nutrients, Measurement, Population, Chlorophyll, Water pollution effects, Temperature, Carbon, Diatoms, Light, Oxygen, Minnesota. Identifiers: \*Lake Minnetonka (Minn).

Density of planktonic algae, rates of photosynthesis, nutrient concentrations, and other limnological characteristics were recoded during 1968-1970 in different parts of Lake Minnetonka, Minn. In the course of the past 30 years, the density of algae increased 2 or 3 times, and the dominance of diatoms was replaced by that of blue-green algae. A linear

relationship was disclosed between the algae density and the content of total phosphorus within the range of 50 to 200 mg/cu m. A decrease of phosphorus below 45 mg/cu m promises a rapid improvement of the lake quality. The nutrient en-richment of the lake is largely due to the land runoff and storm drainage, rather than the discharge of sewage. A mathematical model of the photosynthetic system was based on the relation between the intensity of illumination and the biomass of algae. The report includes a detailed record to taxa and densities of algae during different months of 1968 and 1969. (Wilde-Wiscon-W71-08670

LOSSES OF MINERAL NUTRIENTS DURING DECOMPOSITION OF TYPHA LATIFOLIA, Savannah River Ecology Lab., Aiken, S.C.

Claude E. Boyd.

Archiv fur Hydrobiologie, Vol 66, No 4, p 511-517, 1970. 4 fig, 1 tab, 11 ref.

Descriptors: \*Aquatic plants, \*Nutrients, \*Solubility, Plant physiology, Degradation (Decomposition), Leaching, Eutrophication, Analysis, South Carolina.

Identifiers: Typha latifolia, Par Pond (SC), Savannah River (SC).

Samples of Typha latifolia were placed into tared bags of fiberglass netting, and either suspended 12 cm above the water, or anchored on the surface of the mud at a depth of 30 cm. The tissues in submerged bags showed a more rapid loss of dry organic matter than the suspended tissues; the determination of nitrogen, phosphorus, calcium, magnesium, potassium and sodium in plant tissues indicated a more rapid return of nutrients to the environment from the submerged plants, accom-plished by microbial mineralization as well as leaching; the latter was particularly conspicuous in the loss of monovalent bases. Aquatic macrophytes decompose more rapidly than terrestrial plants during initial decay stages. (Wilde-Wisconsin) W71-08673

TOXIC EFFECTS OF HEPTACHLOR, Research Inst. of Hygiene, Bratislava (C-

cechoslovakia).

L. Rosival, M. Vargova, and J. Uhnak.
International Chemical Engineering, Vol 10, No 4, p 545-553, 1970. 8 fig, 4 tab, 16 ref.

Descriptors: \*Pesticide toxicity, \*Heptachlor, \*Pesticides, Soils, Agriculture, Water pollution sources, Path of pollutants, Chlorinated hydrocarbon pesticides, Public health, Persistence, Environmental effects, Pesticide kinetics, Laboratory tests. Identifiers: Biological pathways, Heptaclor epoxide, Histopathological changes.

To estimate the risks of heptachlor residues in human foood, small animals were administered residues of heptachlor in farm products grown in soil impregnated with this insecticide. In soils treated with 5 kg/ha, gas chromatography with electron capture detection revealed on the average 0.05 ppm, and in beets 0.37 ppm of heptachlor. The acute toxic effect of heptachlor in mice and rates is given. Acute intoxication of rats was accompanied by histopathological and electron-optical changes in the liver and kidneys. After weeks, experiments confirmed cumulation of heptachlor epoxide in the liver of rabbits (more than times the concentration in the feed) and especially in fat (more than 10 times the concentration in the feed) after feeding beets grown on soil impregnated with helptachlor. After feeding corn grown on such soil and containing less than 0.01 ppm of hep-tachlor, no cumulation was found in the liver and fat of ducks. Cumulation of heptachlor epoxide in fat requires a certain threshold concentration (0.01-0.05 ppm) of heptachlor in the feed. (Jones-Wisconsin) W71-08675

## OBSERVATIONS ON THE SMALL-SCALE DIS-

TRIBUTION OF ESTUARINE PHYTOPLANK-TON, Maine Univ., Walpole. Ira C. Darling Center for Research; and Maine Univ., Walpole. Dept. of Zoology. B. J. McAlice.

Marine Biology, Vol 7, No 2, p 100-111, 1970. 4 fig, 12 tab, 30 ref.

Descriptors: \*Phytoplankton, \*Estuaries, \*Distribution, Spatial distribution, Distribution patterns, Rhode Island, Maine, Population, Density, Statistical methods.

Identifiers: \*Phytoplankton patches, Asterionella japonica, Chaetoceros laciniosus, Skeletonema costatum, Ditylum brightwelli, Rhizolinia delicatula, Rhizosolenia setigera, Rhizosolenia fragilissima, Thalassiosira nordenskioldii, Thalassiosira decipiens, Thalassiosira gravida, Leptocylindrus danicus, Nitzschia seriata, Guinardia flaccida, Striatella unipunctata, Prorecentrum triangulatum, Peridinium triquetrum, Peridinium trochoideum, Olisthodiscus luteus, Narrangansett Bay (RI), River (Me), Thalassionema

Population densities of phytoplankton were studied in collections of eight series comprising 94 individual collections. Density differences were demonstrated by analyses of variance in the series when the collecting interval was more than 10 cm. Statistically significant differences in the popula-tion densities of individual species were found in most collection series. The data also suggest that various species are affected differently by the agents responsible for small-scale variability. Individual species in any series are generally overdispersed. In Series IV total cell counts and colony counts of the three most abundant species were analyzed. Phytoplankton patches ranging in size from 1 to 21 m were tentatively identified. No correlation was found between temperature or salinity and the small-scale distribution of individual species. Counts taken on the ebb tide showed population densities were substantially higher than those taken in the flood tide. Throughout the 3 or 4 week bloom, Asterionella japonica was consistently more abundant in the upstream portion of the estuary and occurred there in markedly longer chains. Some indications of patch sizes in the various horizontal series can be obtained from Tukey's multiple comparisons test. (Jones-Wisconsin) W71-08677

#### METABOLICALLY ACTIVE SPHEROPLASTS OF BLUE-GREEN ALGAE (IN RUSSIAN), Moscow State Univ (USSR). Dept. of Microbiolo-

gy. M. V. Gusev, K. A. Nikitina, and T. G.

Korzhenevskaya.

English summary. Mikrobiologiya, Vol 39, No 5, p 862-868, 1970. 5 fig, 2 tab, 15 ref.

Descriptors: \*Algae, \*Metabolism, \*Cytological studies, Photosynthesis, Respiration.

Identifiers: \*Lysozyme, \*Spheroplasts, Blue-green algae, Anabaena variabilis, Anacystis nidulans.

The use of lysozyme permitted a quantitative separation of spheroplasts from the cells of bluegreen algae Anabaena variabilis and Anacystis nidulans. The yield of spheroplasts was correlated with the concentration of lysozyme, the volume of reaction mixture, conditions of mixing, and the period of incubation. The tolerance of cells to lysozyme was dependent on the species and the growth phase of algae. Spheroplasts of A variabilis exhibited endogenous respiration at the rate similar to that of the intact cells. A decrease in the content of phycocyanin immobilized the ability of spheroplasts to emit oxygen in light, thus confirming the critical role of phycocyanin in photochemical reactions. (Wilde-Wisconsin)
W71-08683

CONTINUOUS SYSTEM MODELS OF OXYGEN **DEPLETION IN A EUTROPHIC RESERVOIR,**Oklahoma State Univ., Stillwater. Dept. of Chemis-

try.
For primary bibliographic entry see Field 06A.

## INTERACTIONS BETWEEN DDT AND RIVER FUNGI. I. EFFECTS OF p,p'-DDT ON THE GROWTH OF AQUATIC HYPHOMYCETES, Salford Univ. (England). Dept. of Biology. S. A. Dalton, Madeline Hodkinson, and K. A.

Applied Microbiology, Vol 20, No 5, p 662-666, 1970. 3 fig, 43 ref.

Descriptors: \*DDT, \*Fungi, \*Rivers, \*Growth rate, \*Aquatic plants, Nutrients, Permeability, Metabolism, Ecology, Cycling nutrients, Insecticides, Aquatic animals, Microorganisms, Pesticides.

Identifiers: \*Hyphomycetes, \*Growth enhancement, Heliscus submersus, Tetracladium setigerum, Varicosporium elodeae, Clavariopsis aquatica.

Effects of concentrations of 0.1 and 60 mg/ml DDT on the Hyphomycetes, Heliscus submersus, Tetracladium setigerum, Varicosporium elodeae, and Clavariopsis aquatica, four aquatic fungi, are studied. Concern for the potential long-term hazards of environmental contamination warranted investigation of the interactions between the insecticide and the aquatic microorganisms. DDT concentration below 2 mg/ml did not affect the growth of the fungi, at higher insecticide concentrations their growth rates were enhanced, increasing with increased concentration; the presence of the insecticide did not alter form of growth curves. In natural waters DDT concentrations rarely exceed 2 mg/ml. These fungi may be insensitive to environmental insecticide exposure; H submersus appears a more sensitive organism. The increased mycelial yields enhanced by the DDT might have resulted from DDT being used as a nutrient, DDT affecting the permeability of the fungal cells to other nutrients, or DDT increasing the metabolic rate of the fungi in the capacity of a cofactor. There may be ecological significance in this DDT enhancement of growth rate since these fungi decompose organic debris and cause the recycling of nutrients in the freshwater environment. (Jones-Wisconsin)

## STIMULATORY PROPERTIES OF FILTRATE

FROM THE GREEN ALGA HORMOTILA BLENNISTA. I. DESCRIPTION,
Providence Coll., R.I. Dept. of Biology; and Connecticut Univ., Storrs. Biological Sciences. Thomas J. Monahan, and Francis R. Trainor.

Journal of Phycology, Vol 6, No 3, p 263-269, 1970. 3 fig, 4 tab, 37 ref. OWRR Project A-014-CONN (3).

Descriptors: \*Algae, \*Growth rates, \*Productivity, \*Plant growth substances, Photosynthesis, Metabolism, Bacteria, Hydrogen ion concentration, Laboratory tests.

Identifiers: \*Green algae, \*Hormotila blennista, Filtrates, Growth autostimulation, Growth regulation, Extracellular products, Algal excretions.

Autostimulation of growth by filtrates of Hormotila blennista is attributed to secretion of organic metabolites. The maximum stimulation in excess of 100% was exerted by filtrates obtained from 1 to 4 week old actively growing cultures. The filtrates supported bacterial growth and stimulated the growth of Scenedesmus at pH 6.3, but not at pH 7.7. Stimulatory properties of filtrates were termade that extracellular secretions of H blennista influence the survival of the alga and the growth of other organisms. (Wilde-Wisconsin) W71-08687 minated by autoclave treatment. A suggestion is

FOOD OF LOGPERCH (PERCINA CAPRODES), AND BROOK SILVERSIDE (LABIDESTHES SICCULUS), IN A NEW AND OLD OZARK RESERVOIR,

Bureau of Sport Fisheries and Wildlife, Fayet-

teville, Ark. James W. Mullan, Richard L. Applegate, and William C. Rainwater.

Transactions of the American Fisheries Society, Vol 97, No 3, p 300-305, 1968. 2 fig, 3 tab, 12 ref.

Descriptors: \*Fish, \*Food habits, \*Reservoirs, Silversides, Perches, Plankton, Aquatic insects, Crustaceans, Arkansas, Missouri. Identifiers: \*Bull Shoals Reservoir (Ark-Mo), \*Beaver Reservoir (Ark-Mo), White River (Ozarks), Percina caprodes, Labidesthes sicculus, Euplankton, Tendipeds, Terrestrial spiders.

A comparison was made of food habits of the logperch, Percina caprodes, and the brook silverside, Labidesthes sicculus, inhabiting a 14-yr-old impoundment and a reservoir in the process of filling. The logperch in the new basin preferred aquatic insects to an exclusion of microcrustaceans; the silverside in the same reservoir ingested both foods and terrestrial spiders, but disdained the planktonic Chaoborus. In the older reservoir the logperch sustained on a mixed diet of benthic crustaceans and aquatic insects, whereas the silverside was largely dependent on insects. (See also W70-04190 and W70-05421) (Wilde-Wisconsin) W71-08688

#### ECOLOGY OF YEASTS IN POLLUTED

Illinois Inst. of Tech., Chicago. Dept. of Biology. Lynn L. Wollett, and L. R. Hedrick. Antonie van Leeuwenhoek, Vol 36, No 3, p 427-435, 1970. 1 fig, 3 tab, 42 ref.

Descriptors: \*Yeasts, \*Water pollution, \*Distribution patterns, Environmental effects, Water pollution effects, Industrial wastes, Domestic wastes, Oligotrophy, Fermentation, Sampling. Identifiers: Rhodotorula, Cryptococcus, Candida, Mycelium.

The density and composition of extant yeasts were determined in 3 freshwater habitats exhibiting low pollution level (A), heavy industrial waste pollution (B), and heavy domestic waste pollution (C). The habitat A was dominated by Rhodotorula and Cryptococcus isolates, whereas the station B - by Rhodotorula and Candida; the majority of isolates at location C were Candida with Rhodotorula being actionation C were candida with knootorula being second in abundance. All waters had large yeast population, averaging about 3,000 yeasts per 100 ml, but attaining at times density as high as 27,000/100 ml. The high proportion of Candida was correlated with the presence of human wastes.
(Wilde-Wisconsin) W71-08690

## CHEMICAL ANALYSES OF SOME VASCULAR AQUATIC PLANTS, Savannah River Ecology Lab., Aiken, S.C.

Claude E. Boyd.
Archiv fur Hydrobiologie, Vol 67, No 1, p 78-85, 1970. 4 tab, 22 ref.

Descriptors: \*Aquatic plants, \*Chemical analysis, \*Pigments, Chlorophyll, Nutrients, Plant morphology, Phenology, Inorganic compounds,

Identifiers: Par Pond (SC), Savannah River (SC).

Lush green specimens of some vascular aquatic plants were collected from a relatively homogenous sector of the impoundment (Par Pond, South Carolina) and analyzed for total alkalinity, ammonia, nitrates, phosphorus, sulfur, calcium, magnesium, potassium, sodium, iron, manganese, copper, zinc, chlorophyll-a and b, and carotenoids. The results indicated the range of inter-specific variation in chemical composition of plants, but provided no basis for a prediction of the levels of

#### **Group 5C—Effects of Pollution**

chemical constituents in a particular aquatic community. (Wilden Wisconsin) W71-08691

#### FIRST EXPERIMENTS OF MUSSELS PURIFI-CATION WITH ELECTROPHORESIS,

Messina Univ. (Italy). Inst. of Hygiene. G. S. Gabbrielli, and E. La Pergola.

Revue Internationale d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Institut National de la Sante et de la Recherche Medicale, Fondation de la Ville de Nice, Nice, Vols 28 and 29, p 261-270,

Descriptors: \*Shellfish, \*Mussels, \*Electrophoresis, Coliforms, E. coli, Water pollution effects, Water purification, Bacteria, Water pollution. Identifiers: \*Purification.

Experiments to verify the capabilities of electrophoresis for the purification of mussels and other edible shellfish were conducted. Samples of mussels contaminated with E. coli transferred to the electrophoretic tank and exposed to a voltage of six and twelve volts for ten, twenty, thirty and forty minutes showed a decrease but not a complete removal of bacteria. Six and twelve volts for forty minutes removed 90-95% of the coliform from mussels with low contamination. (Ensign-

W71-08721

## COASTAL WATERS POLLUTION AND MOL-LUSKS CULTURE, PROPOSAL FOR PRODUC-TION, COMMERCE AND PURIFICATION OF MOLLUSKS,

Ufficiale Sanitario e Medico Provinciale di Toran-

to, Italy. A. Leccese, and N. Clerico.

Revue Internationale d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Institut National de la Sante et de la Recherche Medicale, Fondation de le Ville de Nice, Nice, Vols 18 and 19, 1970, p 253-

Descriptors: \*Coasts, \*Aquiculture, \*Mollusks, Pollutants, \*Industrial wastes, \*Municipal wastes, Legislation, \*Ultraviolet radiation, Water reuse, Water pollution effects.

With the increase in coastal water pollution by urban and industrial wastes it is more and more difficult to find near-shore water appropriate for the culture of mollusks. Proposals for the production, commerce and legislation of mollusk culture are suggested. Several reclamation methods are in use, however, the method found to be most effective is one which makes use of sea water previously treated with ultraviolet rays which were found not to alter the organolectical characteristics of crustaceans, mollusks and plankton. (Ensign-PAI) W71-08722

### THE PRESENT STATUS OF DISEASES CONNECTED WITH MARINE POLLUTION.

Public Health Labs., Exeter (England).

Revue Internationale d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Institut National de la Sante et de la Recherche Medicale, Foundation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 193-223, 28 ref.

Descriptors: \*Water pollution effects, \*Diseases, Environmental sanitation, \*Infection, \*Public health, Bacteria, Microorganisms, Coasts. Identifiers: England.

Studies on sewage contamination of coastal waters were conducted by a group of British public health bacterioligists. The most effective methods of control are assessed as to whether control of the environment is necessary, or immunization with ap-

propriate vaccines. A disesase may be proved to be caused by pollution before the organism has been isolated in the laboratory. Also the isolation of a pathogenic agent from the environment does not prove that the environment is a danger to health. Monitoring procedures to determine the diseases present in a specific community and the assessment of whether the environment monitored is dangerous in its own right, are considered. Relevant diseases to consider are those in which transmission is usually by the faecal-oral route, particularly water-borne diseases. Diarrhoeal diseases, polio-myelitis and infectious hepatitis are discussed in detail. Shellfish pollution is briefly mentioned. (Ensign-PAI) W71-08726

## PRESENCE OF POLYNUCLEAR AROMATIC HYDROCARBONS IN COASTAL WATERS AND THE POSSIBLE HEALTH CONSEQUENCES,

World Health Organization, Copenhagen (Denmark). Regional Office for Europe. Michael J. Suess

Revu Internationale d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Institut National de la sante et de la Recherche Medicale, Foundation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 181-

Descriptors: Pollutants, \*Industrial wastes, \*Municipal wastes, Fish, \*Food chains, \*Public health, Coasts, Estuaries, Water pollution effects, \*Aromatic compounds, Plants.

Identifiers: Polynuclear aeromatic hydrocarbons, Endogenic synthesis, Carcinogens.

Carcinogenic polynuclear aromatic hydrocarbons are distributed widely throughout the world, being found in coastal waters near heavily populated areas as well as in remote unpopulated zones. Endogenic synthesis of flora appears to a major contributor, however, PAH concentrations in coastal waters and estuaries may be increased by industrial and municipal effluents and atmospheric precipitation. Though no definite evidence exists that waste effluents polluting our seafood, have become an actual environmental cancer hazard to the general population it is still wise to remain concerned to forestall problems in the future. (Ensign-PAI) W71-08727

#### AQUACULTURAL DEVELOPMENT AND PUBLIC HEALTH,

Food and Agriculutre Organization of the United Nations, Rome (Italy). Inland Fishery Resources Branch.

H. R. Rabanal.

Revue Internationale d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Institut National de le Sante et de la Recherche Medicale, Fondation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 155-167, 40 ref.

Descriptors: \*Aquiculture, \*Proteins, \*Food chains, \*Human population, \*Public health, Pollutants, Sewage, Fertilizers, Pesticides, Industrial wastes, Radioactive wastes, Water pollution ef-

Large scale development of aquaculture to meet the current and future shortage of high quality animal protein for the increasing world population discussed. Several institutions and agencies in different parts of the world are actively engaged in investigations to establish aquaculture. In a number of countries, particularly in Asia and the Far East, the culture of sih and shellfish in brackish waters is rapidly expanding. There are certain public health problems associated with acquacultural development. Environmental changes brought about by impoundment of estuarine and coastal areas may result in increased hazards of water-borne diseases. Sewage effluents and animal manures as fertilizers for aquaculture, the uptake and accumulation of pesticide residues, industrial by-products, radioactive wastes and other pollutants and the danger of eating contaminated fish or shellfish grown in polluted water are all dangers to be considered. To deal effectively with the public health aspects of aquaculture close collaboration between medical scientists, aquaculture specialists and international agencies such as FAO and WHO is necessary (Ensign-PAI) W71-08728

STUDY OF THE FILTER ACTIVITY OF CERTAIN MARINE ANIMALS (SALPA, CIONA, AM-TAIN MARINE ANIMALS (SALPA, CIONA, AMPHIOXUS) WITH RESPECT TO LABELLED BACTERIA, COMPARED TO THE ACTIVITY OF CERTAIN EDIBLE MOLLUSKS, (ETUDE DE L'ACTIVITE FILTRANTE DE CERTAINS ANIMAUX MARINS (SALPA, CIONA, AMPHIOXUS) A L'EGARD DE BACTERIES MARQUEES, COMPAREE A L'ACTIVITE DE CERTAINS MOLLUSQUES COMESTIBLES (MYTILUS. TELLINA)). CERTAINS MOLLUSQUES COMESTIBLES (MYTILUS, TELLINA)),
Naples Univ. (Italy). Instituto di Igiena.
M. R. Mazzara, R. Guidone, M. A. Mazzara, and H.

F Roecker.

Revue International d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medical, Institut National de la Sante et de la Recherche Medicale, Fondation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 131-

Descriptors: \*Self-purification, \*Bacteria, \*Water purification, Water pollution control, Sea water, Water pollution effects.
Identifiers: \*Filtering organisms, Ciona, Amphiox-

us, Salpa, Salmonella.

The filtering mechanism of some 'filter feeders', ciona, amphixus, and Salpa were studied for their purifying action. Test-bacteria used were Salmonella (Ratin strain) labelled with p32 and a paratuberculous bacilus (Pasteur No 607). Macroscopic demonstration of this activity was accomplished by dying bacteria with Rhodamin B and was strengthened by normal and fluorescent microscopy after dying with Ziel-Nielsen and Auramin. The determination of radioactivity of filtering organisms, using a geiger counter and bacteria labelled p32, permitted a qualitative or quantitative evaluation of the phenomena of predation. (Ensign-PAI) W71-08730

ANTIBIOSIS PHENOMENA OF PHYTOPLANK-TONIC ORIGIN IN THE MARINE ENVIRON-MENT, ANTIBACTERIAL SUBSTANCES TONIC ORIGIN IN THE MARINE ENVIRONMENT, ANTIBACTERIAL SUBSTANCES PRODUCED BY A DIATON ASTERIOMELLA JAPONICA, (PHENOMENES D'ANTIBIOSE D'ORIGINE PHYTOPLANCTONIQUE EN MILIEU MARIN, SUBSTANCES ANTIBACTERIENNES PRODUITES PAR UNE DIATOMEE ASTERIONELLA JAPONICA), Centre d'Etudes et de Recherches de Biologie et d'Occanographie Medicale, Nice (France). M. Aubert, D. Pesando, and M. Gauthier. Revue Internationale d'Oceanographie Medicale, Revue Internationale d'Oceanographie Medicale,

Revue Internationale d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Institut National de la Sante et de la Recherche Medicale, Fondation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 69-76.

Descriptors: \*Self purification, \*Bacteria, \*Phytoplankton, \*Marine bacteria, \*Soil bacteria, Chromatography, Water pollution effects.

Identifiers: Mediterranean phytoplankton, Antibacteria substances.

In situ investigations of several Mediterranean phytoplanktonic species producing antibacterial substances were observed. More than 25% showed antagonistic activity against terrestial bacterial flora. Asterionella japonica synthesized a fatty acid and a nucleoside. These substances were isolated from cell extracts by gel chromatography and studied in detail by physical and chemical processes. Results suggested that these biosecretions play an important role in marine equilibrium. (Ensign-PAI)

#### Effects of Pollution—Group 5C

FURTHER CONTRIBUTIONS TO THE STUDY OF THE BIOPRODUCTIVITY IN POLLUTED MARINE ECOSYSTEMS, Mediterranean Marine Sorting Center, Salammbo

(Tunisia). Jose Stirn.

Revue Internationale d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Institut National de la Sante et de la Recherche Medicale, Fondation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 21-27.

Descriptors: \*Sewage bacteria, \*Bacteria, \*Organic wastes, \*Primary productivity, Phytoplankton, Water quality, Ecology, Water pollution ef-

Identifiers: \*Nannochloris oculata.

Non toxic organic sewage introduced into a marine water mass changes the chemical composition and the ecological condition of the mass. A higher density of primary productivity and a predominance of certain phytoplanktonic species are observed.
Comparisons of very polluted areas of water with areas only slightly polluted showed a very high rate of Nannochloris oculata in the highly polluted areas. Studies of cultures of Nannochloris oculata in different medias show a definite elevation in the presence of organic sewage. (Ensign-PAI) W71-08739

THERMAL POWER, AQUATIC LIFE, AND KILOWATTS ON THE PACIFIC COAST, Pacific Gas and Electric Co., Emeryville, Calif. En-

gineering Research Dept.

James R. Adams. Nuclear News, Vol 12, No 9, p 75-79, Sept 1969. 5 fig, 1 tab, 10 ref.

Descriptors: \*Thermal power, \*Cooling water, \*Dissolved oxygen, Discharge measurements, Water temperature, Aquatic life, California, Water pollution effects.

Because of the differing physical processes involved, the evaluation of factors effecting aquatic life from cooling water discharged from thermal electric power plants should be studied primarily at the site rather than in a laboratory. The physical, chemical and biological effects of heated water discharges were measured at 15 California stations. From 17 papers and 68 mimeographed reports, some representative studies in three catagories from stations in both estuarine and open ocean environments are summarized: (1) thermal tolerance studies, (2) dissolved oxygen measurements and (3) natural temperature changes. Studies on the thermal tolerance of fish include assessment of the effects not only of the temperature changes, but of the size of the area influenced by the discharge and the time which an organism is subjected to particular temperature elevations. Contrary to some laboratory evidence, field evidence reviewed demonstrated that the temperature increase does not cause a change in the dissolved oxygen content of the water. Daily recordings of natural temperature flucuations, which often exceed 20 deg F in some bays and at various depths in the open ocean, show that marine animals and plants are exposed to substantial natural fluctuations. (Hollister-PAI)

SOME ASPECTS OF MARINE PHYTOPLANK-TON STUDIES NEAR THE COLUMBIA RIVER, WITH SPECIAL REFERENCE TO A SUBSUR-FACE CHLOROPHYLL MAXIMUM,

Washington Univ., Seattle. Dept. of Oceanography.

George C. Anderson.

Available from the National Technical Information
Service as RLO 1725-168, \$3.00 in paper copy, \$0.95 in microfiche.

Descriptors: \*Phytoplankton, \*Hydrography, \*Nutrients, \*Primary productivity, \*Chlorophyll, \*Rivers, Water pollution effects, Oregon, Washington, \*Columbia River. Identifiers: Species distribution, Size fractionation.

Studies begun in 1961 of the phytoplankton and primary production processes off the Washington and Oregon Coasts and the effects of the Columbia River on these waters are presented. Seasonal and areal distributions of phytoplankton concentrations and primary production rates are given along with relationships of these distributions to the areas hydrography. Also mentioned are size fractionation hydrography. Also mentioned are size fractionation of phytoplankton populations in different seasons and locations, populations adaptation to light, phytoplankton excretion of dissolved organic matter, and the seasonal and vertical distribution of particulate matter. Mechanisms regulating the supply of nutrients to surface waters and to supply of nutrients to surface waters and to processes which form chlorophyll concentrations at various depths and the importance of these chlorophyll layers to production processes in the effluent area of the Columbia River outfall are emphasized. (Ensign-PAI) W71-08741

RELEASE OF DISSOLVED ORGANIC MATTER BY MARINE PHYTOPLANKTON IN COASTAL AND OFFSHORE AREAS OF THE NORTHEAST

PACIFIC OCEAN,
Washington Univ , Seattle. Dept. of Oceanography.
G. C. Anderson, and R. P. Zeutschel.
Available from the National Technical Information
Service as RLO 1725-167, \$3.00 in paper, \$0.95 in

Descriptors: \*Phytoplankton, \*Organic matter, \*Photosynthesis, \*Coasts, \*Pacific Ocean, Water pollution effects, Eutrophication, Oligotrophy. Identifiers: \*Particulate organic matter, \*Dissolved organic matter, \*Liquid Scintillation counting.

The rate of release of dissolved organic matter from phytoplankton photosynthesis in offshore and coastal areas of the northeast pacific ocean was measured. A scintillation solution with high counting efficiency was used which allows sampling to be done easily and accurately at sea. Surface and eutrophic waters showed greatest absolute amounts of dissolved organic matter release, however, relative to total production, release was greatest in oligotrophic waters. Production of particulate or-ganic matter and dissolved organic matter release were closely correlated. (Ensign-PAI)

BENTHIC INFAUNA COMMUNITIES OFF THE COAST OF WASHINGTON AND IN PUGET SOUND: SPECIES COMPOSITION AND STRUCTURE OF THE OFFSHORE COMMUNI-

Washington Univ., Seattle. Dept. of Oceanography. Ulf Lie, and Dale S. Kisker.

Available from the National Technical Information Service as RLO 1725-174, \$3.00 in paper copy, \$0.95 in microfiche. July 10, 1970. 22 p.

Descriptors: \*Benthos, \*Coasts, \*Animals, Water pollution effects, Washington, Amphipoda. Identifiers: \*Infauna, \*Puget Sound, \*Species composition, \*Community structure, Polychaetes, Lamellibranchs, Echinoderms.

The species composition and the structure of three benthic communities were studied off the coast of Washington during 1967 and 1968. The deepwater community was in depths of 154. 5m and mean mud-percentage was 50.09%. In the intermediate death and better community was in the community was found at least the community was in the depth sand-bottom community was found at depths of 95.8m with mean mud-percentage 30.86%. The shallow water community was at depths of 36.0m with a mean sand percentage of 96.33%. The most abundant species and the mean standing crop for each of the depths was determined. The variability in community diversity is discussed. Lower diversity was found in the shallow water sand-bottom community than in the deeper communities. (Ensign-PAI) W71-08744

ANALYSIS **EXPERIMENTAL** BEHAVIOR IN SYMBIOSES, California Univ., Santa Barbara. Dept. of Zoology.

Demorest D. Davenport.

Available from the National Technical Information Service as AD-716 633, \$3.00 in paper copy, \$0.95 in microfiche. Final Technical Report to Office of Naval Research Contract NONR 4222 (03). 53 p, 10 fig, 4 tab, 60 ref. Office of Naval Research Project No NR-104-275.

Descriptors: \*Symbiosis, \*Animal behavior, \*Ecosystems, \*Aquatic environment, Social aspects, Water pollution effects. Identifiers: Chemoreception, Mechanoreception.

The communication machinery which brings together intimately associated marine species (symbioses) is analyzed. Many types of stimuli are involved and their function is considered in relation to the ecology of the specific organisms and the environment where they are found. The capacity and competency of visual and chemical signals in the sea are emphasized. (Ensign-PAI) W71-08748

THE POLLUTION OF THE COASTAL OCEAN AND THE GREAT LAKES,

For primary bibliographic entry see Field 05B.

ECOLOGICAL EFFECTS OF POWER-PLANT COOLING,

Oak Ridge National Lab., Tenn. Ecological Sciences Div. Charles C. Coutant.

Preprint Ecological Problems in the Marine Environment, 1st National Biological Congress, American Institute of Biological Sciences and Federation of American Societies for Experimental Biology, p 15-26, November 10, 1970, 3 fig, 1 tab.

Descriptors: \*Environmental effects, \*Ecology, \*Powerplants, \*Water pollution control, \*Thermal pollution, Sites, Design, Monitoring, Control systems, Pollution abatement, Heated water.

Ecological problems associated with thermal pollution from power plants are discussed. These problems include a need for: 1) studies of biological changes caused; 2) multidisciplinary approaches; 3) standardization of site selection and surveying practices; 4) consistent temperature standards and regulations for maintaining water quality; and 5) an education of public attitudes. A review of literature on the biological and ecological effects of temperature changes is given. A discussion of steps in power-plant site selection and discharge design is presented, including a table out-lining the pertinent ecological effects to be con-sidered. An effective monitoring program must: 1) show if design changes are needed in the thermal discharge system to protect aquatic life; and 2) contribute toward quantitative models of thermal effects applicable to designing new effluent systems. Mention is made of the over 363 federal, state and utility research programs on thermal pollution problems presently being conducted throughout the country. (McEntyre-PAI) W71-08762

POSSIBLE EFFECTS OF A SEA-LEVEL CANAL ON THE MARINE ECOLOGY OF THE AMERICAN ISTHMIAN REGION,

Battele Memorial Inst., Columbus, Ohio. Columbus

W. E. Martin, J. A. Duke, S. G. Bloom, and J. T. McGinnis.

Preprint Ecological Problems in the Marine Environment, 1st National Biological Congress, American Institute of Biological Sciences and Federation of American Societies for Experimental Biology, p 3-14, November 10, 1970. 1 tab.

Descriptors: \*Ecology, \*Environmental effects, \*Canals, \*Oceans, \*Mixing, Ecosystems, Aquatic habitats, Migration, Open channels. \*American Isthmian Identifiers: Region, \*Proposed sea-level canal.

#### **Group 5C—Effects of Pollution**

Scientists have questioned the possible long-term ecological consequences of reuniting the Pacific and Caribbean biota via a sea-level canal. This preliminary report of research undertaken by the Bioenvironmental and Radiological-Safety Feasibility Program presents a literature survey summary of the marine ecology and physical oceanog-raphy of the isthmian region, and explores the marine habitats and biotic communities on both sides of the listhmus, the role of mathematical modeling in studies of possible mixing processes, and the predictions of physical, biological, faunistic and floristic consequences. Conclusions from the ecological information available suggest net water flow would be from Pacific to Atlantic, with passive migration of planktonic organisms occuring likewise from Pacific to Atlantic. No evidence was found for predicting serious economic effects on fisheries or for mass migrations with widespread competition and extinction. (McEntyre-PAI) W71-08763

MONITORING ECOLOGICAL CHANGES IN

THE MARINE ENVIRONMENT, Clapp (William F.) Labs., Inc., Duxbury, Mass. For primary bibliographic entry see Field 05A. W71-08766

WATER POLLUTION FROM PHOSPHATE, Alice Q. Howard

EnFo, January 1971, 4 p, 1 tab.

Descriptors: \*Phosphates, \*Detergents, \*Water pollution effects, \*Water pollution control, \*Biodegradation, Fishkill, Eutrophication, Algal

blooms, Water quality. Identifiers: Enzyme presoaks, Dishwater detergents, NTA.

An evaluation of water pollution by phosphates in household detergents is presented. The distinction is made between biodegradability, or the breakdown ability of the cleaning agent of detergents in waste water, and the phosphate problem. Phosphates are placed in detergents to act as water softeners to make the cleaning agent more effective. The cycle of pollution effects from phosphate-induced plant growth include excessive algae blooms, excessive oxygen use as the plants later die, and finally suffocation of animal life such as fishes. The USDI estimates that 50-70% of phosphorus in city sewage comes from detergents. Phosphate substitutes such as NTA require extensive research to be sure they do not cause problems of their own. Enzyme presoaks and automatic dishwater detergents have high phosphate levels. Suggestions for consumer action to reduce phosphate use are given, including a list of detergents and their phosphate per load content. (McEntyre-PAI) W71-08768

#### **PESTICIDES PLOYCHLORINATED BIPHENYLS IN ESTUARIES,**

Bureau of Commercial Fisheries, Gulf Breeze, Fla. Center for Estuarine and Menhaden Research.
Thomas W. Duke.
Preprint, Ecological Problems in the Marine En-

vironment, 1st National Biological Congress, American Institute of Biological Sciences and Federation of American Societies for Experimental Biology, p 27-32, November 10, 1970.

Descriptors: \*Pesticides, \*Pesticide toxicity, \*Estuarine environment, \*Industrial wastes, \*En-\*Pesticide toxicity, vironmental effects, Pesticide residues, Estuaries, DDT, Chlorinated biphenyls. Identifiers: \*Polychlorinated biphenyls.

A survey is presented on pesticides and polychlorinated biphenyls (PCBs) and their water pollution effects in estuaries. Sources of pesticides are agricultural area run-off, direct application for insect control, and municipal and industrial effluents, while sources of PCBs are industrial effluents. Various monitoring programs have located pesticide residues in fish and shellfish. Examples of

effects of pesticides on ecosystems are given, such as regional declines of the speckled seatrout, the altering of capacity of phytoplankton to photosynthesize, mortality and abnormalities in crabs fed brine shrimp nauplii containing DDT, affects a containing DDT, affects a containing declaration of the statement of the stateme fects on embryonic development and larvae of filter-feeding mollusks, and death of sheepshead minnows. PCBs, including Aroclor 1260 and Aroclor 1254, have been located in bays and estuation in the control of the cont ries, in seals, porpoises, birds, fish, mussels, and shellfish. Bioassays conducted to determine effects of Aroclor 1254 on estuarine organisms show that the animals can concentrate the PCB, which can be toxic at concentrations in the ppb range. Realizing the potential hazard of PCBs, the Monsanto Chemical Company has recently announced that PCB sales would be limited to only those who could control disposal of the final product. A continual monitoring program of estuaries for toxic materials and effects is a necessity. (McEntyre-PAI)

NUTRIENT MANAGEMENT IN THE POTOMAC ESTUARY, Federal Water Quality Administration, Annapolis,

Md. Chesapeake Support Lab. Norbert A. Jaworski, Donald W. Lear, Jr., and

Orterio Villa, Jr.

Technical Report 45, January 1971, 69 p, 21 fig, 3

Descriptors: \*Estuaries, \*Nutrients, Water quality control, \*Ecology, \*Algae, \*Eutrophication, Nutrient requirements, Municipal wastes. Identifiers: \*Potomac River Estuary.

The water quality of the upper Potomac Estuary has been degraded as a result of municipal wastewater from the metropolitan area of Washington.
Past studies indicated high coliform densities, low dissolved oxygen content, and large populations of blue-green algae as major water quality manage-ment problems of the upper and middle areas of the estuary. Studies and concepts used to formulate a nutrient management program for the Potomac Estuary are presented. Current water quality conditions and ecological trends are discussed. The sources, controllability, transport and criteria establishment of nutrients are discussed and suggestions for wastewater treatment requirements and a water quality management program are made. (Ensign-PAI) W71-08775

BIOLOGICAL AND OCEANOGRAPHICAL SURVEY OF THE SANTA BARBARA CHAN-NEL OIL SPILL 1969-1970, VOLUME I: BIOLOGY AND BACTERIOLOGY; VOL II: PHYSICAL, CHEMICAL AND GEOLOGICAL STUDIES.

University of Southern California, Los Angeles. Allan Hancock Foundation.

Allan Hancock Foundation, University of Southern California, Sea Grant Publication No 2, 1971, Vol 1, 426 p, Vol. 2; 477 p.

Descriptors: Water pollution effects, Water pollution control, \*Environmental effects, \*Oil wastes, Oily water, Water pollution sources, Aquatic animals, Aquatic habitats, California, Sampling, Pollutant identification. Identifiers: \*Oil spills, \*Santa Barbara (Calif).

On February 20, 1969, the Western Oil and Gas Association awarded a research grant to the Allan Hancock Foundation, University of Southern California, to study the biological and oceanographical effects of oil spillage in the Santa Barbara Channel following the 1969 blowout. The grant was for a twelve month field study so that indications of recovery, as well as damage, could be studied. The results summarized data available from government agencies, including the California State Water Quality Control Board, the California Department of Fish and Game, the Federal Water

reau of Commercial Fisheries. Unfortunately not all of the data were available due to restrictions imposed pending several legal suits. The results of these research papers in Volume I were compiled by Dr. Dale Straughan and edited by Mrs. D. Hal-mos. Papers in Volume II were compiled and edited by Dr. Ronald L. Kolpack. (See also W71-08777 thru W71-08801) W71-08776

HISTORICAL NATURAL OIL SEEPS: BACKGROUND,

BACKGROUND, University of Southern California, Los Angeles. Allan Hancock Foundation. C. Ventura, and J. Wintz. In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol. 1, Biology and Bacteriology, p 11-16, 1971, 16 ref.

Descriptors: \*Oil, \*Seepage, History, \*Oily water, Water pollution sources, Surface waters, California, Water pollution effects.
Identifiers: \*Santa Barbara Channel.

Natural oil seeps in the Santa Barbara Channel were recorded prior to Spanish settlements in the 1780s. Indians used the material for waterproofing and mending canoes; Cabrillo mentions tarry sub-stances in Santa Barbara Bay and in 1543 seamen passing the area record the smell of bitumen. Numerous journals and shiplogs contain similar reports of submarine seeps. Recent photographs of these seeps show three types of oil release: 1) small beads concentrated over crusty white sediments; 2) tar mounds from which teardrops of viscous material with whiplike tails escape, and 3) globules, released at two to three second intervals. Depending on the nature of the seepage, daily releases range from 11 to 160 barrels, with an average loss being 50 to 70 barrels. Plotted positions of known offshore seeps include one near Platform A, site of the 1969 Santa Barbara Channel oil spill. (See also W71-08776) (Moe-PAI) W71-08777

## PRIMARY PRODUCTIVITY IN THE SANTA BARBARA CHANNEL, University of Southern California, Los Angeles.

Allan Hancock Foundation.

M. Oguri, and R. Kanter.

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol. 1, Biology and Bacteriology, p 17-48, 1971. 18 fig, 2 tab, 9 ref.

Descriptors: \*Phytoplankton, \*Aquatic productivity, \*Environmental effects, \*Oily water, Sampling, On-site data collections, Cruises, California, Water pollution effects. Identifiers: \*Santa Barbara Channel.

Artificial alterations in the environment join natu-Artheria alterations in the environment join half-ral environment cycles to effect changes in phytoplankton production, thus effecting the amount of energy available for most sea organisms. The Santa Barbara Channel oil blowout in January 1969 substantially increased the amount of oil already present from natural oil seeps. To determine the effects of increased quantities of oil, samplings of normal phytoplankton productivity were made, first at 11 stations in the eastern part of the Santa Barbara Basin, and then during five cruises of the entire basin. Results are shown in tables and graphs. The possibility of low productivity resulting from the presence of surface oil did not appear to be substantiated by the data. (See also W71-08776) (Moe-PAI) W71-08778

OBSERVATIONS ON THE ZOOPLANKTON OF THE EASTERN SANTA BARBARA CHANNEL FROM MAY, 1969 TO MARCH, 1970, University of Southern California, Los Angeles.

Allan Hancock Foundation. Diane Robbins McGinnis.

Quality Administration, and the United States Bu-

#### Effects of Pollution—Group 5C

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol. 1, Biology and Bacteriology, p 49-59, 1971. 2 tab, 3

Descriptors: \*Zooplankton, Water pollution effects, Sampling, \*Environmental effects, \*Oily water, \*Aquatic productivity, \*Distribution patterns, Sampling, Aquatic populations, California, Pollution identification.
Identifiers: \*Santa Barbara Channel.

Methods of collecting and studying samples of surface plankton taken over a ten-month period from the Santa Barbara Channel are discussed. Purpose of the study was to determine the influence of the January 1969 Santa Barbara oil spill on zooplankton ecology. Comparative data, collected over several seasons, are required to establish normal several seasons, are required to establish normal parameters of zooplankton variability. Within the limits of the study discussed, it was observed that zooplankton was present at all stations all year, being most abundant in January 1970, least in September 1969 and that penilia avirostris was recorded for the first time in Southern California neritic waters. Percentages of the number of specimens counted in each major taxonomic group are shown in accompanying tables. (See also W71-08779)

## THE BENTHIC FAUNA IN THE SANTA BARBARA CHANNEL FOLLOWING THE JANUARY, 1969, OIL SPILL,

University of Southern California, Los Angeles. Allan Hancock Foundation.

Kristian Fauchald.

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol. 1, Biology and Bacteriology, p 61-116. 8 fig, 5 tab, 11 ref.

Descriptors: \*Benthic fauna, \*Aquatic productivity, \*Plant populations, \*Mortality, \*Environmental effects, Water pollution effects, \*Oily water, Pollution identification.
Identifiers: \*Santa Barbara Channel, \*Listriolobus.

A decrease in the standing crop of benthic fauna was reported through surveys taken from 1956 to 1960; studies made after the January 1969 Santa Barbara Channel oil spill show that the standing crop of macro-invertebrates continues to decrease dramatically. Several reasons could cause the decrease: abnormally high rainfall, increase in sewage due to increased human population, well drilling operations, and the oil spill. However, the lack of data from 1960 to 1969 makes it impossible to pinpoint the exact cause of the population reduction. A large-scale program is needed to monitor the benthos. Increased human activity in the area can only be deleterious, therefore a minimal program of exploitation is recommended. The diminishing Listriolobus beds on the Santa Barbara shelf are unique to that area and must be preserved. (See also W71-08776) (Moe-PAI) W71-08780

#### SOME POLYCHAETOUS ANNELIDS FROM THE SANTA BARBARA SHELF AREA,

University of Southern California, Los Angeles.

Allan Hancock Foundation.

Raymond Emerson. In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 1, Biology and Bacteriology, p 117-147, 1971. 4 tab.

Descriptors: \*Annelids, \*Benthic fauna, \*Distribution patterns, \*Aquatic habitats, \*Oily water, Sampling, Water pollution effects, California, Pollutant identification.

Identifiers: \*Santa Barbara Channel.

Twelve of 32 polychaete families collected in samplings of the Santa Barbara shelf area, and comprising 70 percent of the total polychaete

sampling, were analyzed to species. Samplings were taken from depths ranging from 11 to 110m., with 32 percent at 40 to 50m. For 46 Species collected, a systematic analysis is given, listing diagnostic characteristics, distribution and habitat data. Tables of distribution of species in five types of sediment and by depth are given. Several new species were identified in the investigation, which was part of an extensive survey of fauna done after the January 1969 oil spill in Santa Barbara Channel. (See also W71-08776) (Moe-PAI) W71-08781

### NOTES ON SOME OPHIUROIDS FROM THE SHELF OFF SANTA BARBARA,

University of Southern California, Los Angeles, Allan Hancock Foundation.

Jack Wintz, and Kristian Fauchald.

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 1, Biology and Bacteriology, p 149-158, 1971. 1 fig, 3

Descriptors: \*Benthic fauna, \*Distribution patterns, \*Aquatic habitats, Sampling, Water pollution effects, California, Pollutant identification.
Identifiers: \*Santa Barbara channel, \*Ophiuroids, \*Amphiodia.

Physical and habitat characteristics of Amphiodia digitata and A. urtica are compared, as part of a study of ophiuroids collected in a benthic fauna survey taken after the January 1969 Santa Barbara oil spill. A. urtica is the dominant ophiuriod in the area sampled. Depth distribution findings indicated that the species may be more frequent in deep water rather than in intermediate depths, a contrast to earlier studies of the entire Southern California coast. Habitats for nine ophiuroids collected are briefly described. (See also W71-08776) (Moe-PAI) W71-08782

## A STUDY OF THREE SANDY BEACHES IN THE SANTA BARBARA, CALIFORNIA, AREA, University of Southern California, Los Angeles.

Allan Hancock Foundation.

Thomas Trask

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 1, Biology and Bacteriology, p 159-177, 1971. 15 tab.

\*Invertebrates, \*Beaches, water, \*Distribution patterns, \*Density,
\*Crustaceans, Mollusks, Water pollution effects,
California, Pollutant identification. Identifiers: \*Santa Barbara Channel.

An investigation of species density of invertebrate infauna on Santa Barbara's sandy beaches was made, to determine seasonal variation of the number and abundance of species. The sampling was begun six months after the Santa Barbara Channel oil blowout. As no similar studies were made at the area prior to the blowout, conclusions cannot be drawn about the effect of the spill. Samples were collected from July 1969 to April 1970, at Carpinteria State Beach, Coal Oil Point Beach and Ellwood Beach. They were taken along predetermined lines at low tide. Tables list the number of specimens collected of species of crustacea, polychacta and mollusca, as well as of insect larvae and unidentified nemertea. (See also W71-08776) (Moe-PAI) W71-08783

## A STUDY OF THE BACTERIAL POPULATION OF BOTTOM SEDIMENTS IN THE SANTA BARBARA CHANNEL AFTER THE OIL SPILL, University of Southern California, Los Angeles. Allan Hancock Foundation. Sister Damien Marie Juge.

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 1, Biology and Bacteriology, p 179-222, 1971. 33 fig, 9 tab, 2 ref, 4 plates.

Descriptors: \*Aerobic bacteria, \*Bottom sediments, \*Oily water, \*Drainage water, \*Density, Water pollution effects, California. Identifiers: \*Santa Barbara Channel.

Observations made of bacterial populations in waste fields after the Santa Barbara Channel oil slick conflict with prior studies. The Santa Barbara study was intended to observe the effect of in-creased levels of oil and its degradation products in the benthic and sedimentary bacterial population. Materials and methods of the research are described. Until the oil content of individual sediment samples is determined, conclusions can not them samples is determined, concusions can not be drawn; therefore, this paper is considered to be a preliminary report. Data are presented in tables and graphs, showing counts of aerobic bacteria per gram net weight at specific depths at nine sampling stations. (Moe-PAI) W71-08784

# BREEDING AND LARVAL SETTLEMENT OF CERTAIN INTERTIDAL INVERTEBRATES IN THE SANTA BARBARA CHANNEL FOLLOW-ING POLLUTION BY OIL, University of Southern California, Los Angeles. Allan Hancock Foundation.

Dale Straughan.

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 1, Biology and Bacteriology, p 223-244, 1971. 1 fig, 4 tab, 14 ref, 1 plate.

Descriptors: \*Oily water, \*Intertidal areas, \*Invertebrates, \*Larvae, \*Breeding, Water pollution effects, Mussels, Bloodworms, Crabs, California. Identifiers: \*Santa Barbara Channel, \*Goleta

To determine effects of oil on breeding and larval of those exposed to sublethal doses of oil from natural seepage and on those which survived the January 1969 Santa Barbara oil spill. Species, chosen from a variety of habitat, represented barnacles, mussels, limpet, sand crab and bloodworm. Samples were collected from seep and non-seep areas in and near the Santa Barbara Channel from Goleta Point. They were examined for amount of Goleta Point. They were examined for amount of oil on the animal, new settlement, and the number of adults breeding. Effects on reproduction depended upon the species. Findings are reported in the text and in tables. (See also W71-08776) (Moe-PAI) W71-08785

#### OIL POLLUTION AND FISHERIES IN THE SANTA BARBARA CHANNEL,

University of Southern California, Los Angeles. Allan Hancock Foundation.

Dale Straughan.

Bate Stradgman of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 1, Biology and Bacteriology, p 245-254. 4 fig, 2 tab, 1

Descriptors: \*Oily waters, \*Fish populations, \*Fishing, \*Fishkill, Water pollution effects, California. Identifiers: \*Santa Barbara Channel.

Despite reports of smaller yields of fish caught by commercial and party boat fishermen after the January 1969 Santa Barbara oil spill, post-spill surveys made by the California Department of Fish and Game indicate few variations from earlier surveys. Fish sampled appeared healthy and well fed; species diversity was reported maintained. Lower yields were attributed to a reduction of fishing boats entering the area, because fishermen either feared that fish would be contaminated or were unwilling to take extra time to clean oil from boats and gear. (See also W71-08776) (Moe-PAI) W71-08786

WHALES, DOLPHINS AND OIL POLLUTION, Johns Hopkins Univ., Baltimore, Md. Dept. of Pathobiology.

#### Group 5C—Effects of Pollution

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 1, Biology and Bacteriology, p 255-276, 1971. 3 tab, 20 ref.

Descriptors: Water pollution effects, \*Mammals, \*Animal behavior, \*Migration, \*Mortality, \*Oily waters, Aquatic animals, California. Identifiers: \*Santa Barbara Channel, \*Mass media, \*Whales, \*Dolphins.

Newspaper and journal reports cited oil contamination as the cause of death of several whales and dol-phins stranded after the January 1969 Santa Barphins stranded after the January 1909 Santa Bar-bara Channel spill. Brief accounts of these reports are presented, followed by discussion of the in-dividual whale strandings and the probable cause of death. In highly publicized cases when newspapers linked whale death directly to the oil spill, autopsies and tissue analysis revealed no unusual presence of oil. Also the number of gray whale strandings in 1969 did not significantly differ from that of previous years. An account of gray whale feeding and migration habits is included. (See also W71-08776) (Moe-PAI) W71-08787

OIL CONTAMINATION AND ELEPHANT SEAL MORTALITY: A 'NEGATIVE' FINDING, California Univ., Santa Cruz. Crown Coll.

Burney J. Le Boeuf.

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 1, Biology and Bacteriology, p 277-285, 1971. 3 fig, 2

Descriptors: Water pollution effects, \*Oily water, \*Aquatic animals, \*Migration, Tagging, \*Mortali-

ty, California. Identifiers: \*Santa Barbara Channel, \*San Miguel Island, \*Seals, Elephant seals.

The crude oil that coated 100 weaned elephant seal pups a month after the Santa Barbara Channel spill apparently had no deleterious effect on the pups' health. Through the National Park Service, the animals were examined and specimens analyzed. No oil was found in tissue of two dead seals or in blood samples from the few sick ones. Because of the incompleteness of the Park Service report, more information was sought through a tagging sur-vey, to see if the pups would be effected after they went to sea. In 15 months following tagging, 40% of the oil groups pups were sighted, compared to 25% in the particular of the public of t in the control group. Except for one oil group animal, all animals were reported in apparent good health. Only one showed traces of oil. The data supported earlier conclusions while adding information on absence of long-term deleterious effects. (See also W71-08776) (Moe-PAI) W71-08788

#### CALIFORNIA SEA LION MORTALITY: NATU-

Pathobiology and; California Univ., Santa Cruz. Crown Coll

Robert L. Brownell, Jr., and Burney J. Le Boeuf. In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 1, Biology and Bacteriology, p 287-306, 1971. 2 fig. 1 tab, 37 ref.

Descriptors: Water pollution effects, \*Oily water, \*Aquatic animals, \*Pesticides, Reproduction, Mammals, California.

Identifiers: \*Santa Barbara Channel, \*San Miguel Island, California sea lion.

The small amount of information on mortality, abortion and premature birth rates of the California sea lion is reviewed. Included are data on the possible association of pesticides and oil pollution on sickness and mortality in pinnipeds. Although mass media reported that the several sea lion deaths on San Miguel Island were caused by oil from the January 1969 Santa Barbara Channel spill, investigators found the death rate to be within normal limits, and believe that oil contamination had only a small, if any, deleterious effect on the pups. Also given is a report on the effects of organochlorine pesticides, as DDT and DDE; effects vary greatly among different species of pinnipeds. Frequency data is needed for evaluating future calamites. (See also W71-08776) (Moe-PAI)

OIL POLLUTION AND SEA BIRDS, University of Southern California, Los Angeles. Allan Hancock Foundation.

Dale Straughan.

Bate Straughan.
In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 1, Biology and Bacteriology, p 307-312, 1971. 2 tab,

Descriptors: \*Oily water, Water pollution effects, \*Mortality, \*Birds, \*Water birds, California. Identifiers: \*Santa Barbara Channel.

An estimated loss of 3,600 birds in a two-month period can be attributed to the January 1969 Santa Barbara Channel oil spill. Loons and grebes had the highest death rates, with cormorants and pelicans second. The count was made on 75.5 miles of beach, from Point Conception to Ventura. Swimming species had the highest mortality rate. Oil causes fine elements of plumage to adhere together breaking down the capacity of feathers to insulate birds from cold water. Specific species mortality figures are given. (See also W71-08776) (Moe-PAI) W71-08790

#### SANTA BARBARA'S OILED BIRDS,

California Univ., Santa Barbara. Barbara Drinkwater, Maurine Leonard, and Susan

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 1, Biology and Bacteriology, p 313-324, 1971. 2 fig.

Descriptors: \*Water birds, Water pollution effects, \*Oily water, \*Rehabilitation, \*Cleaning, Treatment, California.
Identifiers: \*Santa Barbara Channel, Oil-drenched

Birds Treatment Center.

Successes and failures in treating oil-drenched birds at a treatment and rehabilitation center which opened after the January 1969 Santa Barbara Channel spill are described. Volunteer workers, none of them ornithologists, began the long procedure by washing birds in warm water with a non-toxic dispersant. They developed several methods for internal treatment, sometimes successful, sometimes not. Problems were many, feeding, food size, diet, floor covering, warmth. Some were solved in inventive ways, as putting tobacco bag booties on feet and legs treated with a moisturizing ointment. Recommendations are given on volunteer training, handling methods and facilities. Because it is necessary to act quickly to save oildrenched birds, methods of handling should be investigated and available. (See also W71-08776) (Moe-PAI) W71-08791

## THE SANTA BARBARA OIL SPILLS OF 1969: A POST-SPILL SURVEY OF THE ROCKY IN-

TERTIDAL, University of Southern California, Los Angeles. Allan Hancock Foundation. Nancy L. Nicholson, and Robert L. Cimberg.

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 1, Biology and Bacteriology, p 325-399, 1971. 18 tab, 25 ref, 9 plates.

Descriptors: \*Marine plants, \*Oily water, Water pollution effects, \*Intertidal areas, \*Invertebrates, Algae, California. Identifiers: \*Santa Barbara Channel.

Differences between the January 1969 Santa Barbara oil spill and earlier spills, as the 1957 Tampico Maru accident and the 1969 Torrey Canyon accident are compared. In the two ship incidents, massive kills of intertical organisms were due to toxic components in diesel oil or dispersants. Spectular effects were not found at the Santa Barbara intertidal, even after a year study. Comparisons are made of marine plant populations from monthly samplings taken at ten rocky intertidal stations in and outside of the spill area. Selection of sampling sites, sampling methods used, and treatment of the data accompany detailed discussion of study findings. Many species are listed in extensive tables that chart the study findings. (See also W71-08776) (Moe-PAI) W71-08792

# WHAT HAS BEEN THE EFFECT OF THE SPILL ON THE ECOLOGY IN THE SANTA BARBARA CHANNEL, University of Southern California, Los Angeles. Allan Hancock Foundation.

Dale Straughan.

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 1, Biology and Bacteriology, p 401-426, 1971. 1 fig, 5 tab, 11 ref.

Descriptors: \*Oil, Seepage, Water pollution effects, Environmental effects, \*Benthic fauna, \*Invertebrates, \*Fish populations, \*Mortality, \*Algae,

Identifiers: \*Santa Barbara Channel.

Because many questions lack answers, the effect on ecology of the 1969 Santa Barbara Channel oil spill may never be known. Environmental factors such as prior natural seepage, heavy rains, increased sedimentation and a possible increase in pesticides, contribute to the problems of isolating oil spill effects. Evidence suggests increased productivity of benthic fauna in inshore waters after the spill, due possibly to increased nutrients. Studies of sandy beach fauna showed no direct effects. Invertebrates whose shells were covered with oil appeared healthy. Fish surveys indicate a stable fish population and there is no proof that oil was directly responsible for marine mammal deaths. High mortality rates were recorded in pelagic bird populations, marine grass, barnacle species and in marine algae. Hypotheses are presented as to why the spill caused so little damage to the area's coology, especially when compared to other spills. (See also W71-08776) (Moe-PAI) W71-08793

#### PHYSICAL CHARACTERISTICS OF SANDY BEACHES IN THE SANTA BARBARA CHAN-NEL AREA.

University of Southern California, Los Angeles. Dept. of Geological Sciences. Ronald L. Kolpack.

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 2, Physical, Chemical and Geological Studies, p 7-63, 1971. 35 fig, 1 tab, 3 ref.

Descriptors: \*Beaches, \*Sands, \*Beach erosion, \*Water circulation, \*Weather patterns, \*Distribution patterns, \*Oil, Water pollution effects, Califor-

Identifiers: Santa Barbara coast.

Observations of the movement of beach sand to determine if oil deposited on beaches altered normal seasonal changes were part of a study made after the January 1969 Santa Barbara Channel spill. Profile measurements using a closely spaced grid were taken of changes at ten mainland beaches for one year. Records were kept of sediment and water samples, wave period and height, orientation water samples, wave period and neight, orientation of the shoreline and approaching waves, water and air temperature, cloud cover, wind speed and direction, and longshore drift velocity. Photography was also used. Graphs of beach profiles and other findings accompany the text. Through natural cycles, beaches returned to normal within the

#### Effects of Pollution—Group 5C

year. Deposition of oil on the beaches did not significantly alter the normal movement of beach sand. (See also W71-08776) (Moe-PAI)

#### STUDY OF BEACH FORAMINIFERAL POPULATIONS IN THE SANTA BARBARA CHANNEL AREA, University of Southern California, Los Angeles. Dept. of Geological Sciences. Ronald W. Morin.

In: Biological and Oceanographical survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 2, Physical, Chemical and Geological Studies, p 64-89, 1971. 13 fig, 12 ref.

Descriptors: Water pollution effects, \*Oily water, \*Mortality, \*Zooplankton, Beaches, Aquatic populations, Distribution patterns, California.

Identifiers: \*Santa Barbara Channel,

\*Foraminifera.

After the January 1969 Santa Barbara Channel Spill, an eleven-month study was made of the effects of oil pollution on beach foraminiferal populations. Frequency distribution of species found on 12 beaches is discussed as well as graphed. The faunal changes of foraminifera seem to be the result of seasonal variations. The possibility of a kill-off of the species by oil pollution is remote. (See also W71-08776) (Moe-PAI) W71-08795

#### OCEANOGRAPHY OF THE SANTA BARBARA

University of Southern California, Los Angeles. Dept. of Geological Sciences.

Robert L. Kolpock.

In: Biological and Oceanographical survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 2, Physical, Chemical and Geological Studies, p 90-180, 1971. 72 fig, 3 ref.

Descriptors: Surface waters, \*Water temperature, \*Salinity, \*Circulation, \*Currents, \*Oceanography, Coasts, California, Water pollution effects. Identifiers: \*Santa Barbara Channel.

The many physical, chemical and geological studies undertaken to access the effects of an oil spill in Santa Barbara Channel required thorough knowledge of the oceanography of the area. By combining original research with past studies, water circulation and current patterns were derived for the area. Surface water temperature, salinity and nutrient values reflect the circulation pattern described. Numerous graphs, charts and profiles accompany this report, showing temperature and salinity values, surface water currents as derived from drift card surveys, surface water temperature and nutrients. (See also W71-08776) (Moe-PAI)

#### TRANSPORT AND DEPOSITION OF FLOOD SEDIMENT, SANTA BARBARA CHANNEL, CALIFORNIA,

University of Southern California, Los Angeles. Dept. of Geological Sciences.

David E. Drake, Peter Fleischer, and Ronald L.

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 2, Physical, Chemical and Geological Studies, p 181-217, 1971. 11 fig, 3 tabs, 14 ref.

Descriptors: \*Sediments, \*Sediment transport, \*Sediment distribution, Runoff, Rivers, \*Floods, \*Deposition, Water pollution effects, California. Identifiers: \*Santa Barbara Channel.

The oxidized red-brown river sediment carried into the Santa Barbara Channel during heavy rains and record run-off was easy to trace, as the sediment contrasted with the olive-gray sediment of the channel. The Santa Clara and Ventura Rivers contributed more than 50 x 106 tons of suspended

sediment. Initial deposition of about 40 x 106 tons occurred within 20 kilometers of the river mouths. Eighteen months later, more than 15 x 106 tons had accumulated at depths between 500 and 600m in the central portion of the basin. Information on the distribution of suspended particles within the water column was obtained with a continuouslyrecording beam transmissometer. Mineral composition of the sediment is shown in tables. (See also W71-08776) (Moe-PAI)

## FORAMINIFERAL POPULATIONS IN THE SANTA BARBARA CHANNEL: OFFSHORE SPECIES,

University of Southern California, Los Angeles. Dept. of Geological Sciences.

Ronald W. Morin.

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 2, Physical, Chemical and Geological Studies, p 218-275, 1971. 37 fig, 16 ref.

Descriptors: Water pollution effects, \*Plankton, Mortality, \*Benthos, \*Benthic fauna, Aquatic populations, \*Distribution patterns, Sewage effluents, California.

Identifiers: \*Santa Barbara Channel.

Offshore species of formainifera taken from bottom sediments of the Santa Barbara Channel after the January 1969 oil spill showed populations typical of normal conditions on the Southern California mainland shelf. Charts show the percentages and population sites of living Buliminella elegantissima and Nonionidae over a ten-month period. The former fourishing in sewer effluents of the channel, spread from its usual habitat, while Nonionidae, relatively intolerant of sewer outfall pollution, maintained its usual pattern. (See also W71-08776) (Moe-PAI) W71-08798

#### HYDROCARBON CONTENT OF SANTA BAR-BARA CHANNEL SEDIMENTS,

University of Southern California, Los Angeles. Dept. of Geological Sciences; and Cincinnati Univ., Ohio. Dept. of Chemistry; and Gulf General Atomic Co., San Diego, Calif.

Ronald L. Kolpack, James S. Mattson, Harry B. Mark, Jr., and Ta-Ching Yu.

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 2, Physical, Chemical and Geological Studies, p 276-295, 1971. 9 fig, 5 ref.

Descriptors: \*Sediment distribution, \*Analytical techniques, \*Spectrometers, \*Bottom sediments, \*Oily water, \*Deposition, Water pollution effects, Sediment-water interface, California.

Identifiers: \*Santa Barbara Channel, \*Hydrocar-

Because tar and oil had been observed in shelf and basin sediments collected from the Santa Barbara Channel, the area was selected for a study of hydrocarbon content of surficial marine sediments. The study, begun in late 1968, was intended to evaluate infrared analytical techniques and establish background levels of the hydrocarbon content. Analysis showed higher total hydrocarbon concentrations in areas of maximum oil slick coverage after the January 1969 spill. Subsequently, these hydrocarbons were deposited or redeposited at the sediment-water interface in another part of the channel, and eventually became aligned with the main avenues of sediment transport toward the central basin. Because of the results discussed and supplementary information, researchers believe that estimates of the amount of oil released by the oil blowout are too low. (See also W71-08776) (Moe-PAI) W71-08799

CHARACTERISTICS NEARSHORE SEDIMENTS FROM EL CAPITAN TO VENTURA, CALIFORNIA, 1969-1970. University of Southern California, Los Angeles.

Dept. of Geological Sciences. D. S. Gorsline, B. M. Brenninkmeyer, W. C. Meyer,

M. R. Ploessel, and G. I. Shiller.

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 2, Physical, Chemical and Geological Studies, p 296-317, 1971. 6 fig, 11 ref.

Descriptors: \*Bottom sediments, \*Clays, \*Particle size, \*Sediment distribution, Oily water, \*Sediment transport, Organic matter, Carbonates, California, Water pollution effects.
Identifiers: \*Santa Barbara Channel.

The texture, coarse fraction components, carbonate content and organic carbon content of nearshore bottom sediments were studied from samples taken from Santa Barbara's mainland coast after the January 1969 oil spill. Descriptions and charts review findings, discussing sediment textures, clay, silt and sand distribution, organic content and carbonate content. General sediment trends support the tentative conclusions that the find load is from the Ventural and Santa Clara rivers and that the sand fraction is probably locally derived. Organic contents definitely show the influence of the oil seeps in the Coal Oil Point area; the sand fraction in all samples contained tar bits and plant debris. (See also W71-08776) (Moe-W71-08800

## FORAMINIFERAL POPULATIONS IN THE SANTA BARBARA REGION: NEARSHORE SPECIES,

University of Southern California, Los Angeles. Dept. of Geological Sciences.

Ronald W. Morin.

In: Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill, 1969-1970, Vol 2, Physical, Chemical and Geological Studies, p 318-340, 1971. 12 fig, 10 ref.

Descriptors: Water pollution effects, \*Oily water, Aquatic populations, \*Benthos, \*Benthic fauna, \*Plankton, Sewage effluents, California.
Identifiers: \*Santa Barbara Channel,

Identifiers: \*Foraminifera.

After the January 1969 Santa Barbara Channel oil spill, the size of benthonic foraminiferal populations in the channel were compared to populations in order Southern California areas. The channel populations was found to be either normal or relatively large. High level dead ratios within the are of relatively large populations suggest that higher rates of productivity caused the large populations. Distribution patterns of Buliminella elegantissima and of four members of the Nonionidae were generally typical of normal portions of the Calfornia mainland shelf. Thus, effluent from Santa Barbara sewer outfall probably was not responsible for increased productivity; growth is attributed to either the presence of oil or some other environmental factor. (See also W71-08776) (Moe-PAI)

#### HYDROBIOLOGICAL EVALUATION STREAM AND NEARSHORE SYSTEMS: FIELD STUDIES,

Michigan State Univ., East Lansing. Inst. of Water

For primary bibliographic entry see Field 05A. W71-08880

#### HYDROLOGIC EFFECTS OF STRIP MINING WEST OF APPALACHIA,

Geological Survey, Arlington, Va.

D. J. Cederstrom.

Mining Congress Journal, Vol 57, No 3, p 46-50, Mar 1971. 5 p, 3 photo, 5 ref.

#### **Group 5C—Effects of Pollution**

Descriptors: \*Strip mines, \*Strip mine lakes, \*Hydrogeology, \*Indiana, \*Illinois, Acid mine water, Recreation, Strip mine wastes, Spoil banks, Reservoirs, Recharge, Water levels, Flood control, Water resources development, Base flow, Water

Identifiers: Strip mine hydrology.

In the Midwest the problem of acidic water is seemingly much less acute than in Appalachia. In part, this may be due to the fact that the topography is gentle and pyritic material is generally less exposed to oxygenated waters. In Midwest fields, thousands of small lakes have been created in the resultant ridge and furrow topography. These lakes constitute a reservoir of significant magnitude. Further, upon pumping from lakes, saturated bank material, made up of moderately permeable shale fragments or highly permeable sandstone and limestone fragments, will contribute water to the lakes. In this sense, then, the lakes may be thought of as a series of dug wells in which considerable storage is present in each. The ponds and lakes created by disturbed ground are commonly hydrologic benefits in the sense of improvement of the functioning of the hydrologic cycle and also in a secondary sense in that the ponds and lakes are, or can be, distinct recreational assets. (Knapp-USGS) W71-08899

#### **5D. Waste Treatment Processes**

REACTIONS OF A STRONGLY BASIC ION EXCHANGE RESIN WITH DILUTE AQUEOUS SOLUTIONS IN A COLUMNAR SYSTEM, Michigan Univ., Ann Arbor. Div. of Sanitary and

Water Resources Engineering.
William S. Midkiff, and Walter J. Weber, Jr.

William S. Mickitt, and water J. weber, Jr.
Available from the National Technical Information
Service as PB-199 643, \$3.00 in paper copy, \$0.95
in microfiche. Department of Civil Engineering
Technical Publication T-69-4, Nov 1969, 136 p, 53 fig, 48 ref, 3 append.

Descriptors: \*Ion exchange, Water reuse, Waste water treatment, \*Aqueous solutions, Water chemistry, \*Separation techniques, Anion exchange, \*Resins, Chemical reactions, Kinetics, Chromotography, \*Chemical analysis, Ions, Chromotography, \*Chemical analysis, Ions, Analytical techniques, Mathematical models, Sulfates, Phosphates, Nitrates.

Identifiers: \*Reaction zones, Separation zones.

The objective was an engineering evaluation of the use of ion exchange for removal of selected anions from waste water. The research extended to the technology of water conservation with respect to upgrading the quality of municipal waste water treatment plant secondary effluents and storm ru-noffs for reuse. High molecular weight is not a significant factor in fouling or operational inter-ference of a strong basic anion exchange resin. An organic species must be a counterion before it will penetrate the strong-base resin pore structure to cause foulding. No significant difference in performance was indicated when the one inch column was compared to a column with nine times the surface area. A reaction zone in the column defines the limit of bed depth. As bed depth is increased, chromatographic separation of the ions becomes more prominent. The separate zones become more concentrated and reverse exchange as well as concentration of the less selective ions is enhanced. The reaction zone of the most selective ion is increased with bed depth as an increased competitive ion effect is created with the increased concentration of the less selective ions. A mathematical model has been applied, a modification of one developed by Gleuckauf, combining the effects of equilibrium and kinetics. Analysis of the solute data shows that the more selective the ion, the sharper is the front and the shorter is the reaction zone. The lengths of the reaction zones are in the inverse order from the selectivities. Sulfate has the sharpest front and is followed by phosphate and nitrate. W71-08391

WATER RESOURCE SYSTEM OPTIMIZATION BY GEOMETRIC PROGRAMMING, Texas A and M Univ., College Station.

For primary bibliographic entry see Field 06A. W71-08393

CHEMICAL CHARACTERISTICS OF OR-GANIC COLOR IN WATER,
Washington, Univ., Seattle, Dept. of Civil En-

For primary bibliographic entry see Field 05A. W71-08396

PIPELINE FLOW OF SOLIDS-LIQUID SUSPEN-

Raffi Turian, Tran-Fu Yuan, and Giacomo Mauri. Available from the National Technical Information Service as PB-199 708, \$3.00 in paper copy, \$0.95 in microfiche. July 1970, 122 p, 13 fig, 9 tab, 40 ref. FWPCA Grant No 17070 DUQ.

Descriptors: \*Slurry, \*Hydrodynamics, Fluid friction, Pipes, Flow rates, Reynold's number, Headloss, Hydraulics, Suspended load, Particle size, Manometers, Flow meters, Mixing, Pressure, Analytical techniques, Laboratory tests, Statistical analysis, Sludge.

Identifiers: Drag co-efficient, Glass.

Suspensions containing closely sized beads of varying diameters, made from two types of glass, were allowed to flow through 2,1 and 1/2 inch pipelines. Available slurry flow data in 1/2 inch pipe using glass, steel, and lead particles were combined with these data, resulting in a particle size range of from 31 micron up to 4380 micron. There were 12 particle sizes, and particle densities of 2.3, 3.0, 4.4, 7.5 and 11.3 gm/cc, with the entire data set consisting of 1511 points. From these data points, a slurry flow correlation was developed which predicts the slurry friction factor within an absolute average deviation of 9.5% for the entire data collection, with 74 data points having a deviation exceeding 30% and 9 data points with a deviation greater than 50%. Utilization of the correlation involved recasting of the drag coefficient--Reynold's Number relationship into an empirical expression valid for numbers well within the Stokes flow region, and up to nearly the so-called drag crisis. While most of the data presented was taken in the laboratory, published data from two sources (selected after stringent scrutiny) were used to supplement certain ranges of the Reynold's number. (Lowry-Texas) W71-08397

### FIRST NATIONAL SYMPOSIUM ON FOOD PROCESSING WASTES PROCEEDINGS.

Copy available from GPO, Sup Doc as SOD No 167.13/4: 12060--04/70, \$3.00; microfiche from NTIS as PB-199 709, \$0.95. Conference held Apr 6-8, 1970, at Portland, Oregon, Water Pollution Control Series, 12060--04/70 (1970), 400 p. FWQA Program 12060.

Descriptors: \*Waste water treatment, Water reuse, \*Industrial wastes, Activated sludge, Sludge treatment, Canneries, Aerobic treatment, Oxidation lagoons, Biological treatment, Water pollution control, \*Farm wastes, Filtration.
Identifiers: \*Food processing wastes.

This was the first of a planned series of conferences to discuss current research on treatment of food processing wastes. This Symposium was co-sponsored by Pacific Northwest Water Laboratory of the Federal Water Quality Administration, the Western Regional Research Laboratory of the U. S. Department of Agriculture, National Connections Department of Agriculture, National Canners Association, and Northwest Food Processors Association. The first two days of the conference were devoted to an in-depth review of current research and demonstration projects which have been funded largely by the Federal Water Quality Administration. The third day was concerned with discussions of research on improved in-plant and in-field processing intended to reduce the quantities of waste needing treatment, and replaced the Annual Western Regional Research Laboratory's Collaborators Conference. (See also W71-08399 thru W71-08422) W71-08398

FEDERAL WATER QUALITY ADMINISTRA-TION RESEARCH, DEVELOPMENT AND DEMONSTRATION PROGRAM,

Federal Water Quality Administration, Washington, D. C. Applied Science and Technology, Div. William J. Lacy, and Harold G. Keeler.

Proceedings, First National Symposium on Food Processing Wastes, April 6, 7, 8, 1970, Portland, Oregon, Water Pollution Control Research Series No 12060--04/70, p 5-16.

Descriptors: \*Waste water treatment, \*Water reuse, Laboratories, \*Research and development, Technology, Water supply, Eutrophication, Sludge disposal, Nutrients, Microorganisms, Industrial wastes, Municipal wastes.
Identifiers: \*Demonstration, Renovation.

The efforts on the part of the FWQA to assist municipalities and industries in the prevention of further pollution, and the renovation of waters already polluted consist of three major steps. These steps are research, development, and demonstration and each step plays a vital role in bringing about acceptance of technological improvements. The most critical area at present is the industrial wastes research. Industrial wastewater volume is 2.5 times that of the sewered population, the BOD5 load is 3 times, and the suspended solids load is over two times that of the sewered population, and within the past few years industry's growth rate has been 3 times the growth rate of the sewered population. The expenditures for research laboratories have been and will continue to be the best available form of investment in the future, for without increased technology, man would be buried in his own waste products. Also, the safeguarding of our fast dwindling water supplies has become impera-tive to man's survival. In the future, greater emphasis will come to be placed on non-pollutional disposal of sludge and concentrates. Other areas of increasing emphasis include dissolved nutrient removal, waste water renovation, and re-use, and microorganism removal, particularly viruses. The answers to these problems may well determine the question of the survival of man. (See also W71-08398) (Lowry-Texas) W71-08399

STATUS OF R AND D EFFORTS ON FOOD

PROCESSING WASTES, Federal Water Quality Administration, Corvallis, Oreg. Pacific Northwest Lab.

Kenneth A. Dostal, and Robert J. Barm.

Proceedings, First National Symposium on Food Processing Wastes, Apri 6, 7, 8, 1970, Portland, Oregon, Water Pollution Control Research Series No 12060--04/70, p 17-26.

Descriptors: \*Research and Development, \*Waste Descriptors: 'Research and Development, 'waste-water treatment, \*Industrial wastes, Grants, Water resources development, Technology, Oxidation lagoons, Activated sludge, Trickling filters. Identifiers: \*Food processing wastes.

A brief listing of the major Research and Development grants currently being administered in the Food Wastes Research program is presented. Types of research being funded include research on aerobic lagoons, anaerobic-aerobic lagoons, aerated lagoon oxidation ditches, trickling filters, sludge dewatering, waste incincration, a rotating biological contactor, ion exchange and many others. Types of wastes being studied include fruit others. Types of wastes being studied metade train-and vegetable cannery wastes, slaughterhouse wastes, milk and cheese processing wastes, and beverage wastes. Nearly all Research and Develop-ment work done within the scope of authority of the FWQA in the food processing field is being done through the grant program. As of April, 1970,

#### WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

#### Waste Treatment Processes—Group 5D

45-50 projects were in various stages of comple-45-30 projects were in various stages or completion, with the FWQA providing \$9 million of the \$24 million of total estimated project costs. The Food Wastes Division research program is designed to aid in the fight against water pollution by assisting industry in the development of the technological advances needed. Pollution laws passed by the Federal government are becoming more and more stringent and harder to comply with, providing fines and court injunctions for lack of compliance. This program demonstrates the sincerity of the polthe program demonstrates the sincerity of the pollution control programs by providing industry with the capability for meeting the increased standards. (See also W71-08398) (Lowry-Texas) W71-08400

## STATUS AND RESEARCH NEEDS OF POTATO PROCESSING WASTES, Ruskin, Fisher and Associates, Seattle, Wash.

Kristian Guttormsen, and Dale A. Carlson.
Proceedings, First National Symposium on Food
Processing Wastes, Apr. 6, 7, 8, 1970, Portland,
Oregon, Water Pollution Control Research Series No 12060--04/70, p 27-38.

Descriptors: \*Industrial wastes, \*Water utilization, Reverse osmosis, Activated sludge, Oxidation lagoons, Organic loading, Nutrients, Hydrogen ion concentration, Biochemical oxygen demand, Byproducts, Pilot plants, Ion exchange, Idaho, Waste water treatment

Identifiers: \*Potato wastes, Caustic peeling, Anaerobic filter.

The potato processing industry has experienced un-paralleled growth in the last 2 decades. Along with the large increase in the industry, there has been a correspondingly staggering increase in the amount of waste products produced. At the present time, average values for the processing of one ton of average values for the processing of one ton of potatoes are 4,200 gallons of water used, with a corresponding effluent of 60 lbs of suspended solids and 50 lbs of BOD. In 1966, total annual production of potatoes was estimated at 15 million tons, of which over 35% or 5.25 million tons were processed. Increased production in the potato industry has caused increased interest in methods of alleviating the subsequent pollution. At present, potato processors are faced with having to install secondary treatment facilities at all of their installations. One method of decreasing the cost of secondary treatment is reduction of the waste stream itself. Dry peeling of potatoes has been tested on a small scale, but remains to be proven feasible. If feasible, dry peeling could reduce waste volume and BOD by as much as 50% or more. Also, much research work is being done to find new uses for potato solids, such as cattle feed supplements, culture media, etc. Technology of the potato waste treatment is such that the pollution control objectives can be achieved, but much more work remains to be done before such treatment becomes feasible. (See also W71-08398) (Lowry-Texas) W71-08401

#### AEROBIC SECONDARY TREATMENT OF POTATO PROCESSING WASTES,

Cornell, Howland, Hayes, and Merryfield, Corvallis, Oreg. Glenn A. Richter.

Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series No 12060--04/70, p 39-69, 22 fig, 2 tab.

Descriptors: \*Activated sludge, Industrial wastes, Design criteria, Biochemical oxygen demand, Hydrogen ion concentration, Temperature, Aeration, Mixing, Chemical oxygen demand, Organic loading, Nutrients, Idaho, \*Waste water treatment, \*Sewage treatment, \*Acrobic treatment.
Identifiers: \*Potato wastes, Sludge dewatering,

Suspended solids.

The R. T. French Company of Shelley, Idaho, has been awarded a government demonstration grant to: (1) investigate the feasibility of aerobic secon-

dary treatment of potato wastes; (2) determine BOD removal efficiencies for the system when operated as complete mix activated sludge, a flowthrough aeration system without sludge return, and an intermittent aeration system with periods of aeration, clarification, and supernatant draw off. Also included in the tests were: (1) determination of quantity and character of sludge produced; (2) definition of influence of foaming, ice, temperature, pH, nitrogen, and phosphorus on treatment; and (3) cost evaluations. Plant influent averaged 1730 mg/l alkalinity as CaCO3,1680 mg/l BOD, 3050 mg/l COD, 1430 mg/l TSS, temperature of 20C, and pH of 9.3. On the basis of limited testing, inorganic nutrients were present in sufficient amounts. BOD removals of over 90% were obtained for sustained periods, demonstrating the amenability of potato wastes to aerobic biological treatment. pH values were buffered to prevent system upset. Low temperatures were not sufficient by themselves to cause system upset, although significant temperature losses occurred. A detailed analysis of mechanical problems and corrective modifications is presented. The main emphasis has been centered on the need for specialized equipment design for potato wastes. (See also W71-08398) (Lowry-Texas) W71-08402

#### USE OF FUNGI IMPERFECTI IN WASTE CON-

TROL, North Star Research and Development Inst., Minneapolis, Minn.

Brooks D. Church, and Harold A. Nash.

Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series No 12060--04/70, p 71-89. 6 fig, 7 tab.

Descriptors: \*Fungi, \*Waste water treatment, \*Industrial wastes, Microorganisms, Organic loading, Biochemical oxygen demand, Chemical oxygen demand, Hydrogen ion concentration, Temperature, Nutrients, Oxygenation, Digestion, Cost analysis, Proteins, Filtration.

Identifiers: Fungi Imperfecti, \*Corn wastes, \*Soy

48 SPECIES OF 18 GENERA OF Fungi Imperfecti were studied for conformance to the following qualities: (1) ability for rapid conversion of corn or soy wastes (suspended or soluble) to mycelial protein; (2) case of removal from digested waste stream by coarse filtration. These various types of fungi were tested in order to find a strain which would economically treat the corn and soy wastes, and at the same time have some economic value. Trichoderma viride, Gliocladium deliquescens, and either Aspergillus oryzae or Gliocladium deliquescens gave best results on corn, soy and SO2-containing soy wheys respectively. Optimal growth conditions included pH of 3.2 to 3.5 and temperatures of 30C. Low oxygen levels of 1 lb O2/6 to 7 lb COD removed were required, and nitrogen and phosphates were required for the corn wastes. Such pH adjustments as were required were accomplished through addition of sulfuric acid Laboratory scale testing revealed corn waste reductions from 1600 mg/l BOD to 25 mg/l BOD in the effluent after 24 hours, while soy wastes were reduced from 6200 mg/l BOD to 125 mg/l BOD in 36 hours. Mycelial yields averaged 50 to 60 grams of dry mycelial per 100 gm of COD stabilized. Economic analysis was inconclusive, but laboratory scale data indicated a small profit on soy wastes and sale of fungi as animal supplement would defray 85% of the treatment costs of corn wastes. From these initial observations definite evidence is presented that may evolve into commercial scale use of Fungi Imperfecti to remove BOD in a fullscale plant. (See also W71-08398) (Lowry-Texas) W71-08403

## COMBINED TREATMENT OF DOMESTIC AND INDUSTRIAL WASTES BY ACTIVATED

Cornell, Howland Hayes, and Merryfield, Corvallis,

John L. Graham, and John W. Filbert. Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series No 12060--04/70, p 91-117. 19 fig, 1 tab.

Descriptors: \*Aerobic treatment, On-site investiga-tions, Evaluation, Cost analysis, \*Municipal wastes, \*Industrial wastes, \*Activated sludge, Chlorina-tion, Design criteria, Organic loading, Alkalinity, Nitrates, Phosphates, Coliforms, Sludge, Flexibili-ty, Odors, Oregon, \*Waste water treatment. Identifiers: \*Aerobic digestion, \*Shock loading, Clarification, Dallas (Ore) Clarification, Dallas (Ore).

Conventional approaches to treatment plant design have been found inadequate to provide the necessary degree of treatment, the operational flexibility, and the system stability required. The need for a new system led to the investigation of a completely aerobic scheme of treatment. Such a plant was constructed to handle widely variable combined municipal and industrial wastes, mainly cannery wastes. Average flow through the plant was 2 MGD, with a BOD5 loading of 7,080 lb/day during the canning season, and 2,080 lb/day during the off-season. Various MLSS levels were experimented with ranging from 700 mg/l to 3000 mg/l in the aeration tank. Alkalinity in the influent flow was found to be sufficient to buffer the system. 95% of the time offluent ROD5 was 7 mg/l or less. Total structed to handle widely variable combined muof the time, effluent BOD5 was 7 mg/l or less. Total construction cost of the plant, consisting of aera-tion basins, final clarifier, aerobic digestion, chlorination, and sludge lagoons was \$506,300, as compared to \$950,000 for a conventional plant, or a savings of 47%. Operation and maintenance costs were found to be \$20/1,000,000 gal. treated, or a 70% savings over conventional treatment. The following additional conclusions were drawn from the initial data: (1) enough process flexibility is provided to handle shock organic loads and abrupt loading changes; (2) no special operating problems were caused in this instance by elimination of primary clarification and grit removal; (3) despite large flow and organic loading fluctuations, effluent quality remained consistently good; (4) aerobic digestion provided adequate stabilization for this combination of sludges at a substantial reduction in cost over conventional treatment. (See also W71-08398) (Lowry-Texas)

## AEROBIC TREATMENT OF LIQUID FRUIT PROCESSING WASTE, Gray and Osborne, Yakima, Wash.

Larry A. Esvelt.

Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series, No 12060--04/70, p 119-143. 9 fig, 4 tab, 12 ref. FWQA Research and Development Project 12060

Descriptors: \*Aerobic treatment, \*Industrial wastes, Cost analysis, Evaluation, \*Canneries, Organic loading, Activated sludge, Sludge, Nutrients, Temperature, Flotation, \*Waste water treatment,

\*Oxidation lagoons. Identifiers: \*Contact stabilization, Polyvinylchloride, Clarification, Process control, Surface

Snokist canneries has the capability to process 250 tons/day of pears or peaches, and 100 tons/day of apples. Peak processing wastes flows of 2.0 mgd with BOD outputs (after screening) of 20,000 lbs/day are experienced during peach and pear processing. Three different combinations of two basins, aerated lagooning, activated sludge, and activated sludge with sludge reaeration, were studied to determine their applicability to this type of wastes. Equations for biological growth, aeration requirements, and sludge production were derived from reactor kinetics and applied to this problem. All tests performed to evaluate performance conformed to 'standard methods.' From the results of data taken over two processing seasons, the following conclusions were drawn: (1) both activated sludge and contact stabilization, when loaded at

#### **Group 5D—Waste Treatment Processes**

F/m-.4 on a COD basis, will provide greater than 90% removal of organic load and SS, with activated sludge requiring fewer facilities at lesser cost, (2) aerated lagooning provided 70% removal of BOD, but allowed considerable suspended solids loss which contributed most BOD and COD loss. Howwhich contributed most BOD and COD loss. However, cost for such a system was considerably smaller than for either of the other two systems. Actual costs are \$.041/No.BOD for acrated lagoons, \$.061/No.BOD for activated sludge and \$.067/No.BOD for contact stabilization. Surface aeration, and PVC lining were both found to be suitable for use in all three types of systems. (See also W71-08398) (Lowry-Texas) W71-08405 W71-08405

CANNERY WASTE TREATMENT BY TWO-STAGE AERATION PROCESSES

Oklahoma Univ., Norman. Dept. of Civil Engineer-

ing and Environmental Sciences. Leale E. Streebin, George W. Reid, and Alan Hu. Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series No 12060-04/70, p 145-175, 14 fig, 5 tab, 1 ref. FWQA Demonstration Grant No 12060 DSB.

Descriptors: \*Industrial wastes, \*Canneries, Descriptors: \*Industrial wastes, \*Canneries, Sampling, Design criteria, Aerobic treatment, Organic loading, Flexibility, Odor, Chemical oxygen demand, Biochemical oxygen demand, \*Waste water treatment, \*Aeration.

Identifiers: Extended aeration, Shock loads, Clarification, Volatile suspended solids (VSS).

The Stilwell Canning Company of Stilwell, Oaklahoma processes Irish potatoes, sweet potatoes, blackberries, strawberries, squash, peas, beans, okra, green beans, and other green vegetables. Discharge from the plant previously overloaded the municipal treatment facility by as much as 200%. Data showed that peak output of the plant was 1.5 mgd at a strength of 2250 mg/l of COD. A two-stage aeration process was designed and constructed to treat this waste. A sampling program was developed with sampling points at the Parshall flume, the minimal solids aeration unit, the extended solids acration unit, and after the final clarifier. From the investigation, the two stage aeration system was shown to be capable of accepting shock loads with no adverse affects, partially due to the extreme system flexibility. Recycling of the mixed liquor from the extended aeration system allows minimal solids to be restarted readily. Loading rates varied from an F/m of 1/1 to an F/m of 20/1, while removal ranged from 66 to 99% of the soluble COD. Also, receiving stream D.O. was maintained above 4.0 mg/l over the entire length of the stream for the whole canning season. (See also W71-08398) (Lowry-Texas) W71-08406

#### LIME TREATMENT AND IN-PLANT RE-USE OF AN ACTIVATED SLUDGE PLANT EFFLUENT IN THE CITRUS PROCESSING IN-DUSTRY,

Environmental Engineering, Inc., Gainesville, Fla. Richard H. Jones.

Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series No 12060--04/70, p 177-188.

Descriptors: \*Citrus fruits, \*Industrial wastes, \*Activated sludge, Oranges, Grapefruit, Sludge, Orthe development of the state of Identifiers: Hydraulic loading, Suspended solids, \*Lime treatment.

Winter Garden Citrus Products Co-operative was given 6 weeks in which to find an acceptable treatment method for their wastewater or shut down their operation. On the basis of a 4 week laboratory scale study and no pilot scale study, an activated

sludge plant incorporating lime treatment of the effluent to provide subsequent re-use as barometric leg water and cooling water, was designed and built. Orange and grape fruit wastes per box (90 lbs of fruit) were 25 gallons of concentrated waste water containing 1/4 lb of BOD. The new plant was designed to treat 2 mgd averaging 2000 mg/l of BOD. Waste water loads varied with the availability of fruit, with flow ranging from 1.5 mgd to 0.00 mgd, and from .04 lbs BOD/lb MLSS to .378 lbs BOD/lb MLSS, with a seasons average of .143 lbs BOD/lb MLSS. It was determined that the plant was loaded to approximately 60% of capacity both hydraulically and organically. The following conclusions were obtained after one season of operation: (1) 99% organic removal efficiency is possible using the complete mixed activated sludge process to treat citrus wastes; (2) effluent from the treatment system can be re-used in the plant, and waste sludge and peel can be used as cattle feed; (3) slug additions of orange oil and peel press liquor disrupt treatment efficiency and cause heavy foaming; (4) extensive daily testing must be utilized to determine nutrient requirements due to the highly variable load; and (5) high excess solids production must be considered as a key factor. (See also W71-08398) (Lowry-Texas)

#### CANNERY WASTE TREATMENT BY A HIGH SOLIDS ACTIVATED SLUDGE PROCESS,

FMC Corp., Santa Clara, Calif.

Warren G. Palmer.

Warfen O. Fainer.

Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series, No 12060-04/70, p 227-259. 15 fig, 4 tab, 3 ref. FWPCA Research and Development Grant No

Descriptors: \*Activated sludge, \*Pre-treatment (Water), Industrial wastes, \*Canneries, Sludge, Oxidation, Organic loading, Aeration, Digestion, Biochemical oxygen demand, Hydrogen ion concentration, Phosphorus, Nitrogen, \*Waste water treatment.

Identifiers: Kehr activated sludge process, \*Shock loading, Mixed liquor suspended solids (MLSS), Total organic carbon.

The Kehr modification of the activated sludge process was studied in comparison to the conventional activated sludge process to determine its applicability for industrial waste treatment. The Kehr Activated Sludge Process (KASP) consists of an activated sludge process with a MLSS concentra-tion of 10,000 to 14,000 mg/l, an aeration time of 6 hours and no controlled sludge wasting. Laboratory scale testing runs using a 120 gal acration tank, were conducted. It was determined that KASP has the following advantages (1) because of the high solids concentration, a smaller volume of aeration tank is required to effect the same BOD removal, (2) the high solids concentration provides increased buffering alkalinity, and (3) KASP was able to go for extended periods with no loading, or undergo periods of slug or 'shock' loading with lit-tle adverse effect. On the other hand, KASP does not remove either nitrates or phosphates, and the percent reduction of TOC is also less than can be achieved by conventional plants. From the preceding analyses, the Kehr-Activated Sludge Process appears to have considerable application in industrial situations where widely varying hydraulic and organic loads are encountered, possibly as a pretreatment process. Pilot scale investigations are recommended prior to design to determine design parameters for each individual waste. (See also W71-08398) (Lowry-Texas) W71-08409

#### CONCENTRATION OF SUGARBEET WASTES FOR ECONOMIC TREATMENT WITH BIOLOGICAL SYSTEMS,

Beet Sugar Development Foundation, Fort Collins. Colo

Ronald W. Brenton, and James H. Fischer.

Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series, No 12060--04/70, p 261-280. 10 fig, 2 tab, 6 ref.

Descriptors: \*Sugar beets, \*Industrial wastes, \*Waste water treatment, Ponds, Sedimentation, Oxidation, Aeration, Mixing, Nutrients, Dissolved oxygen, Hydrogen ion concentration, Biochemical oxygen demand, Chemical oxygen demand, Odors, \*Water reuse.

Identifiers: \*Facultative lagoon, Flume water.

Sugar beets provide 30% of the sugar used in the United States. An average of 2200 gallons of water is required per ton of sugar beets for fluming and washing operations. Effluent wastes are discharged from four major sources as: (1) flume water; (2) process water; (3) lime cake drainage; and (4) Steffen or final waste when the Steffen process is used. A two year study on the containment, treat-ment, recirculation, and re-use of sugarbeet fluming and washwater was conducted within the industry. The particular system studied included two alternately used first-ponds in series with a second pond. Removals of BOD and suspended solids average 20 and 54% respectively, with the water continually increasing in BOD, COD, and total dissolved solids the more it was recirculated. At the end of the processing season, system and surplus waters of initial 3000 ppm BOD and 6000 ppm dissolved solids were discharged into a 1.8 surface acerage, 15 ft deep pond having two surface aerators, and degraded to 50 ppm BOD and 4 ppm D.O. Facultative instead of anaerobic digestion prolonged the digestion period to 31 weeks. Inorganic nutrients were limiting, and were added as required. Water was not discharged from the final pond but used as fluming and wash water during the next processing campaign. Control of tempera-ture and pH is vital to odor control. Settleable solids can be removed but solids handling produces greater odor problems which remain to be solved. (See also W71-08398) (Lowry-Texas) W71-08410

#### RECONDITIONING AND REUSE OF OLIVE PROCESSING BRINE,

National Canners Association, Berkeley, Calif. Western Research Lab.

A. Walter Mercer

Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series, No 12060--04/70, p 281-293. 6 fig, 3 tab.

Descriptors: \*Brines, \*Chemical oxygen demand, Hydrogen ion concentration, Acidity, Color, Activated carbon, Economic feasibility, \*Waste water treatment, \*Water reuse.

Identifiers: \*Suspended solids, \*Olive brine, Food

The olive brines used were upgraded by using activated carbon treatment. A brine reconditioning unit was constructed at four canneries. Spent storage brines were put through the carbon column at a rate of 0.5 to 3.5 gpm. Measurement of COD, SS, pH, total acidity, and color were taken and shown in figure 5. Significant change in pH, COD, and total acidity was noted at the addition of fresh carbon. Effluent was transparent, at 425 millimicrons wave length, until 6000 gallons of brine contacted 1000 lb of activated carbon. The transmittance decreased to 75% at 10,000 gallons. SS decreased due to the carbon acting as a filter. The tabulated results indicate that carbon treatment reduced COD and color but had little effect on pH, total acidity, salt content, and SS. Results of treatment of two types of processing water are tabulated and show that the Lye rinse water and the transport brine experienced a substantial reduction in SS and COD. Both rinse waters were reused with no detectable effect on the quality of the product. Also, storage of freshly harvested olives in carbon treated brine was done and proved to be successful. A two stage plan is suggested with a calculated cost for brine treating of \$0.50 per ton of olives for the first stage and \$1.00 for the second stage. (See also W71-08398) (Rayyan-Texas)

#### TRICKLING FILTER TREATMENT OF FOOD CANNING WASTE WATERS,

National Canners Association, Berkeley, Calif. W. Walter Rose.

Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series, No 12060--04/70, p 295-310. 9 fig, 3 tab.

Descriptors: \*Trickling filter, \*Plastic, Toxicity, Hydrogen ion concentration, Organic loading, Chemical oxygen demand, Biochemical oxygen demand, Biochemical oxygen demand, Nutrients, \*Waste water treatment, Filtration, \*Canneries, Industrial wastes.

Identifiers: Depth of packing, Food wastes.

Some conditions resulting in inadequate treatment being provided by trickling filters are: sudden change of volume and character of waste, haulting of operations, deficiency of nutrients, and high concentration of carbohydrates. These observations were made during evaluation of the new plastic filled trickling filters. The factors responsible for actuating this research on these new filters are wastes with high concentrations of soluble solids, necessity for microbial removal of soluble solids, need for high rate space saving treatment method capable of withstanding high organic loadings while still providing efficient removal. The parameters studied were: (1) toxicity, (2) nutrients, (3) pH, (4) organic loadings, and (5) depth of packings. A description of this filter is given along with tables showing its performance under constant and variable loadings. A high or low pH resulted in poor performance. The acceptable pH range was 6.5 to 8.0. An increase in the applied load caused a decrease in percent of BOD removal. A description with an illustrative drawing of the second filter which was used to study the effect of the depth of packing on removal is given. The results which are plotted in two curves show that the removal was disproportionate to depth. This was attributed to hydraulic loading 0.44 gpm/l sq. ft. of cross sectional area and the use of high carbohydrates products. A description of the third filter which used forced aeration is given. It was found that the air flow rate is proportional to COD removal. Results of this study are tabulated. (See also W71-08398) (Rayyan-Texas) W71-08412

#### FOOD PROCESSING WASTE TREATMENT BY SURFACE FILTRATION,

Campbell Soup Co., Camden, N.J

C. Louis Gilde

C. Lous Gilde.
Proceedings, First National Symposium on Food
Processing Wastes, Apr 6,7,8, 1970, Portland,
Oregon, Water Pollution Control Research Series,
No 12060--04/70, p 311-326. 4 fig, 2 tab, 5 ref.

Descriptors: \*Filtration, \*Biochemical oxygen demand, \*Nitrogen, Phosphorus, Agriculture, Climatology, Hydrogen ion concentration, Impervious soils, Slope, Terraces, Conductivity, \*Waste water treatment.

Identifiers: \*Food processing wastes.

This is a new overland flow technique by which waters sprayed on impervious or semi-pervious soils become purified by flowing through vegetative litter on the surface of the soil and collect in terraces at the bottom of slopes. A 3.5 MGD flow of waste water is treated at the Paris, Texas factory of Campbell Soup. A thorough description of this fac-tory is given. The study included climatology, biology, chemistry and agriculture. The climatology study indicated remarkable similarity to the weather bureau records in the east. Thus the latter could be used in predicting the grass growth rate in these areas. Analysis of the grass grown on the disposal site showed high nutritional values ranging up to 23% protein with the hay value being about

8% of the operating cost. Analysis of the effluent indicated a 99% BOD, 90% nitrogen and 45% phosphorus removal. However, a long rest period resulted in 90% phosphorus removal without affecting the BOD or nitrogen. The pH (constant, neutral effluent) and the electric conductivity are illustrated in two figures. A summary of the hydrological data is given. Biological studies indicated that as temperature decreases the number of organisms increases. A 175 ft. down hill slope with a 2%-6% pitch was found to provide sufficient treatment. (See also W71-08398) (Rayyan-Texas) W71-08413

## BIOLOGICAL TREATMENT OF FOOD PROCESSING WASTES,

Stanford Univ., Calif.

Perry L. McCarty.

Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series, No 12060--04/70, p 327-348. 5 fig, 1 tab, 18 ref.

Descriptors: \*Biological treatment, \*Aerobic conditions, \*Anaerobic conditions, Microorganisms, Kinetics, Bacterial, Utilization, Sludge, Nutrients, Methane, Growth rate, Decay rate, Substrate, Velocity, Filter, Fungi, Organic, \*Waste water treatment.

Identifiers: \*Food processing wastes.

This is a summary of the basic principles of biological treatment which have been applied and discussed during the symposium with emphasis on an aerobic process. The major factor in designing a biological treatment system is the reproduction rate of the microorganisms involved. Failure point of the process could be evaluated by considering the kinetics of bacterial growth and waste utilization. A discussion with illustrative drawings and tables ot these factors is presented. Formulas with discussion on excess sludge production, nutrients, and air requirements and methane production are given. The generally used factor of safety against failure is 3-20 times the minimum solid retention time. The biological growth rate coefficient for aerobic system is .3-.4 lb per lb BOD5 or COD consumed and the organism decay rate is .02-.06 per day. The maximum substrate removal velocity was 4-24 lb BOD5 per day per pound of microbial mass. The substrate removal velocity indicates that more waste could be treated per day in a given reactor by increasing the concentration of microorganisms or mixed liquor volatile solids. The anaerobic process has not been widely used. A new system called the anacrobic filter has been developed. A discussion on the operation of this filter is presented with the conclusion that it seems ideal for many food processing wastes but more studies are needed. Comments on food processing waste treatment are presented. (See also W71-08398) (Rayyan-Texas) W71-08414

#### WURDD'S TASK FORCE ON AGRICULTURAL POLLUTION, Agricultural Research Service, Albany, Calif.

Western Utilization Research and Development

J. Peter Clark.

Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series No 12060--04/70, p 347-349.

Descriptors: \*Pollution, \*Foods, \*Water reuse, Toxicity, Oil, Brines, Environment, Water pollution control, Waste water treatment, \*Farm wastes.

The plan of action and the specific research of the task force of WURDD is presented along with a general introduction to some other pollution related research conducted by the division. Modifying food processing is a most promising approach to reducing pollution from agriculture. The general principle to this concept is minimize water use, recycle water or other liquids where possible, put as much of the raw material into the final product

as possible, and make soluble material from whatever cannot go in the primary product. The author considers the present waste stream analysis by the measurement of BOD, COD, SS, etc. inadequate and suggests the analysis of the composition of the stream and its relationship to the environment. Some of the studies done by the division are those on the wastes of castor oil which used to be believed toxic to all animals but was found to be a good nutrient for fish. Also, the study on enzymes and the possibility of growing the useful ones on waste streams and using enzymes to convert or treat waste streams is mentioned along with other current studies. (See also W71-08398) (Rayyan-W71-08415

#### IN-FIELD PROCESSING OF TOMATOES,

Agricultural Research Service, Albany, Calif. Western Utilization Research and Development

R. Joseph Wayna.

R. Joseph Wayna. Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series, No 12060--04/70, p 350-354. 1 fig, 8 ref.

Descriptors: \*Harvesting, \*Tomatoes, Hydrogen ion concentration, Heating, Acid, Solid wastes, Waste water, Cooling, \*Waste water treatment. Identifiers: Food wastes.

5-7 million tons of tomatoes of which 90% are machine harvested are delivered annually to the canneries in the U. S. A description of the machine harvesting and economical and ecological advantages and disadvantages are discussed. It was found that the best way to achieve the utmost yield with the least waste from tomatoe processing is to reduce the in-transit and holding periods by processing the tomatoes in the rural harvesting areas. A tomato processing unit was built with the objective of field processing and the application of a new acidified tomato juice. The unit performed the following: (1) preparation of tomatoes, (2) hotbreak for rapid enzymes destruction, (3) the optional acid treatment, and (4) pulping and cooling. It was found that prompt processing resulted in a 6-12 % increase in product yield. Also, an increase of 4% solids recovery resulted from the use of acid extration and heat treatment over the use of heat treatment alone. All waste material including waste water was disposed on nearby farm land. Juice is the only product to be transported. For stability purposes and at neutral pH (4.4) the juice should be chilled to 40F but it could be held for 24 hours at 70F at a pH of 2.75 without any significant effects. (Sec also W71-08398) (Rayyan-Texas) W71-08416

#### DRY CAUSTIC PEELING OF VEGETABLES

AND FRUITS, Agricultural Research Service, Albany, Calif. Western Utilization Research and Development

P. Robert Graham.

Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series, No 12060--04/70, p 355-358. 2 ref.

Descriptors: Infrared, Heating, Brushing, \*Potatoes, \*Fruit, Water pollution control, Economics, \*Waste water treatment, Farm wastes, Vegatable crops. Identifiers: \*Food wastes.

The study of the dry caustic peeling was done on white potatoes. The process is described in detail but could be summarized by: (1) potatoes are treated with hot lye; (2) they are subjected to infrared heating; and (3) they are then brushed. The experimental unit was composed of a live-roller conveyer, infrared burners and rubber tipped rolls for peeling. The amount of peel removed could be controlled by the caustic dip time. No heat rings were produced under proper conditions. Peeled

#### **Group 5D—Waste Treatment Processes**

potatoes were dipped in sulfite to prevent darkening. Peeling conditions for sweet potatoes are the same as those for white potatoes except the brushing state following the stud rubber peeler is somewhat critical. As for fruit, a caustic chep somewhat critical. As for fruit, a caustic chip similer to that used for conventional peeling is used with a rubber disk peeler and no infrared heating. This method proved to be successful on peaches, pears, and apricots. In general the dry caustic peeling method helps in keeping the peel material from entering the plant effluent as well as resulting in expense in excess of the savings through control of revenue in excess of the savings through control of water pollution. (See also W71-08398) (Rayyan-W71-08417

PILOT PLANT EXPERIENCES OF USDA-MAGNUSON DRY CAUSTIC PEELING PROCESS, Magnuson Engineers, Inc., San Jose, Calif.

J. Traver Smith.

Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series No 12060--4/70, p 359-361.

Descriptors: Infrared, \*Waste water treatment, \*Solid wastes, Pilot plant, \*Potatoes, Fruits, Hydrogen ion concentration, Idaho, Farm wastes. Identifiers: \*Caustic peeling, Magnuscrubber, Magnubrusher, Food wastes.

This pilot plant of dry caustic peeling was constructed at Aberdeen, Idaho. The units used were: (1) small ferris wheel type conventional caustic dip units holding belt; (2) infrared unit, (3) magnuscrubber, and (4) magnubrusher. The product used was white potatoes. Caustic solution of 12% with one minute dip was used. The peel waste was of 23-25% solids at pH 11. Potatoes were dipped briefly 25% solids at pri 11. Potatoes were dispets of the jun a 0.5% sodium bisulphite solution to fix the color. The infrared caustic peeling process definitely accomplished the objective of keeping the peel waste out of the plant waste water. Other advantage of pharmical required vantages include reduction of chemical required reduction of peel waste, and production of whiter and non-slippery processed potatoes. Processing of sweet potatoes using the Magnuson equipment was also found to be successful. Other products are still in the experimental stage. Dry caustic peeling is also called, 'USDA-magnuson anti-pollution peeling system' and also 'infrared caustic peeling.' (See also W71-08398) (Rayyan-Texas) W71-08418

#### POSSIBLE USES OF UNI-FLOW FILTER,

Agricultural Research Service, Albany, Calif. Western Utilization Research and Development

Karel Popper.
Proceedings, First National Symposium on Food
Processing Wastes, Apr 6,7,8, 1970, Portland,
Oregon, Water Pollution Control Research Series No 12060--04/70, p 362-376.

Descriptors: \*Filters, \*Pressure, \*Solid wastes, Liquid wastes, \*Cotton, \*Waste water treatment, Economics, Farm wastes, Water reuse. Identifiers: Suspended solids.

The idea of the uni-flow is to remove some of the noxious material from the effluent at low cost and render the effluent valuable or reusable. The uniflow utilizes the idea of low pressure to separate solids from liquids by the use of cotton tubing (or nylon tubing). A description of the unit is given with illustrative pictures. An example with discussion on the use of the unit in water softener regenerant is presented. Another example is the use of the unit on wine lees. A 50 gpm unit at a cost of \$800 was built. Economic study showed that through use of this unit a recovery of 1000 gallons of wine will require an expenditure of one cent in facilities. The unit was used successfully on potatoe starch with a SS removal of 98%. Other examples of the use of the unit are given. (See also W71-08398) (Rayyan-Texas) W71-08419 A CASE HISTORY IN FOOD PLANT WASTE WATER CONSERVATION AND PRETREAT-MENT EXPERIENCE,

Artichoke Industries, Inc., Castroville, Calif. Granville Perkins.

Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series No 12060--04/70, p 377-382.

Descriptors: \*Precipitation, Flotation, Biochemical oxygen demand, Hydrogen ion concentration, Hydraulic flow, \*Waste water treatment. Identifiers: Suspended solids, \*Food wastes.

This is the history of the waste water treatment problem in an artichoke plant in Castroville, California. The plant started in 1955 using the Castroville County treatment plant which was designed at an average capacity of 300,000 gpd and peak hydraulic load of 900,000 gpd. The plant flow in 1955 was 100,000 gpd and jumped to 400,000 gpd in 1958. A water re-use program reduced the flow to 300,000 gpd but BOD increased from 1500 ppm-4000 ppm. In 1964 an ordinance limiting the gallons of waste and pounds of BOD per industry was issued. The limit of the artichoke plant was 60,000 gpd and 240 lb of BOD at no fee. A consultant was hired to study pretreatment. The result was a chemical precipitation system. This system started operating in 1967 and after one year the value went down to 80,000 gpd with a BOD between 600-1000 ppm. Due to chemical addition the pH jumped from 5.5 to 11 which caused the malfunctioning of the clarifiers of the district treatment plant. Stopping the addition of chemicals allowed the clarifiers to start functioning again but the BOD jumped to 2000 ppm. A new consultant was hired and he suggested flotation of the SS followed by precipitation. This is now under way by converting the 6000 gallon precipitator into an 8000 gallon clarifier. (See also W71-08398) (Rayyan-Texas) W71-08420

ANIMAL FEEDS FROM VEGETABLE WASTES,

Agricultural Research Service, Albany, Calif. Western Utilization Research and Development Div

O. George Kohler.

Proceedings, First National Symposium on Food Processing Wastes, Apr 6,7,8, 1970, Portland, Oregon, Water Pollution Control Research Series No 12060--04/70, p 383-387.

Descriptors: \*Lignin, \*Digestion, Alkali treatment, Dehydration, Grass, Vegetable crops, \*Farm wastes, Economic feasibility, \*Waste water treat-

This is a program report on two agricultural waste problems: The lignified cellulosic material and the non-edible green waste. Lignin, an indigestible substance is associated with the cell wall cellulose and hemicellulose and tends to decrease their digestability. This digestability could be improved by processing straws through treatment. Alkali treatment of a variety of lignified cellulosic wastes and manure improved their digestibility. Studies on the cauliflower plants using a Freeze-dried method indicated that the leaf fraction is a promising poultry feed (28% protein and 12.5% fiber), while the stem fraction is good as a cattle feed with 86.3% digestibility. Economic evaluations of treated straw products and cauliflower waste products are being carried out by computer. (See also W71-08398) (Rayyan-Texas) W71-08421

#### RICE HULL UTILIZATION,

URS Research Co., San Mateo, Calif. Milton Staackmann.

Proceedings, First National Symposium on Food Processing Wastes, Apr 6, 7, 8, 1970, Portland, Oregon, Water Pollution Control Research Series, No 12060--04-70, p 387-390.

Descriptors: \*Burning, \*Dumping, \*Rice, Fuel, Cellulose, Silica, Portland cement, Structure, Architecture, Evaluation, \*Waste water treatment, Farm wastes. Identifiers: Water glass.

A million tons of rice hulls are produced annually in the U. S. and are disposed of either by open air burning or dumping. Both methods are becoming ever more unattractive. The USR company had done a study for USDA examining the technical and economic feasibility of utilizing the rice hulls. The areas examined were: (1) concepts making use of both the fuel value of the organic (cellulose) portion of the hulls and the silica contents, (2) concepts utilizing both the structural characteristics. cepts utilizing both the structural characteristics and the unique texture of the rice hulls and (3) concepts combining both of the above concepts. The first concept was examined with portland cement production and found economically unfeasible. However, the use of rice hulls in water glass production using the Zimmerman process would be production using the Zimmerman process would be economical. The second concept was examined on producing boards for architectural use which proved uneconomical. The combined concept plant having two main processing facilities, one producing sodium silicate, and the other architectural boards using sodium silicate as binder seems to be economical and should be studied further. (See also W71-08398) (Rayyan-Texas)

## CHARACTERISTICS AND KINETICS BIOLOGICAL FIXED FILM REACTORS,

Clemson Univ., S.C. Environmental Systems En-

Billy H. Kornegay, and John F. Andrews.
Available from the National Technical Information Service as PB-199 834, \$3.00 in paper copy, \$0.95 in microfiche. 1970. 212 p, 45 fig, 32 tab, 115 ref. FWPCA Research Grant No WP-01181, Program 17050--00/70.

Descriptors: \*Trickling filter, \*Design criteria, \*Kinetics, Dissolved oxygen, Mixing, Saturation, Diffusion, Biodegradation, Oxidation, Mathematical models, Microorganisms, Waste water treat-

Identifiers: \*Biological bacterial film, \*Plug flow, Glucose, Thickness, Suspended solids.

The kinetics of biological slime films were investigated using six completely mixed, annular reactors. Design criteria for trickling filters were formerly based on experience and guesswork, so this investigation attempted to determine the kinetics of a simple system to provide a better basis for establishing trickling filter design criteria. A simple glucose and mineral base substrate was fed to microorganisms attached to the walls of the 6 annular, completely mixed reactors. The reactors were operated first in parallel, for a basic investigation of biological film kinetics, and second, in series, to approximate plug flow. Completely mixed reactors eliminated channeling, dissolved oxygen and substrate gradients, and the interdependence of velocity and flow. Film development was uniform, and liquid channeling did not occur. This investigation revealed that biological films develop in three distinct stages: (1) logarithmic growth which lasted until the active thickness was reached; (2) linear growth, between the active thickness and the plateau thickness; and (3) zero growth, as all new cells are washed away. The active film thickness averaged 70 and was independent of D. O. Kinetic equations were developed which showed good correlation between theoretical and observed data. On this basis, a trickling filter design equation, based on the kinetics of the process, was developed, (Lowry-Texas) W71-08423

AN INVESTIGATION OF INDUSTRIAL AND MUNICIPAL WASTE WATER QUANTITY, COMPOSITION, AND TREATMENT IN THE REEDY RIVER BASIN,

Clemson Univ., S.C. Environmental Systems Engincering Program.

#### Waste Treatment Processes—Group 5D

James M. Campbell.

MS Thesis, Clemson University. 60 p, 9 fig, 3 tab, 10 ref. OWRR Project B-017-SC (2).

Descriptors: Water quality control, \*Waste assimilative capacity, Industrial wastes, Municipal wastes, Nutrients, Color, Toxicity, Biochemical oxwastes, Nutrients, Color, Toxicity, Biochemical Oxygen demand, Hydrogen ion concentration, Dissolved oxygen, Aeration, Odors, Analytical techniques, Tertiary treatment, Sewers, \*Waste water treatment, South Carolina, \*Water pollution

Identifiers: \*Reedy River Basin, Textile wastes.

Industries and municipalities discharging treated or untreated effluents into the Reedy River Basin were surveyed as to waste volume, strength, and other characteristics. By conventional evaluations of D. O., BOD, and pH, the River was in acceptable of D. O., BOD, and pH, the River was in acceptable condition. Visual observation discounted the analytical evidence, however, and it was determined that the tests developed primarily to municipal wastes were not applicable to the strong textile wastes being discharged to the basin. As a result of the data gathered from the questionnaires, it was decided that there were four choices open to the basin authority, including: (1) expansion of existing plants; (2) construction of an all new regional plant for combined municipal and industrial wastes; (3) construction of a new, centralized textile waste treatment plant to handle most of the industrial wastes in the area; and (4) pumping all wastes into the Reedy River Basin, and adding artificial aera-tion and odor control to the river, since it would be essentially an open sewer. The last alternative, being by far the least expensive would probably be prohibited by state and federal law, public opinion, and aesthetic value loss. No one system has been designed and evaluated for construction as yet, but the alternatives are clearly established. (Lowry-Texas) W71-08424

LITERATURE SURVEY: THE USE OF BAC-TERIA AS INDICATORS OF FAECAL POLLU-TION IN WATER,

Council for Scientific and Industrial Research, Pretoria (South Africa). National Inst. for Water

For primary bibliographic entry see Field 05B. W71-08425

#### GLYCOLYTIC AND RELATED ENZYMES IN CLOSTRIDIAL CLASSIFICATION,

Council for Scientific and Industrial Research, Pretoria (South Africa). National Inst. for Water

J. P. Kotze

Applied Microbiology, Vol 18, No 5, p 744-747, Nov 1969. 22 ref.

Descriptors: \*Clostridium, \*Separation techniques, Analytical techniques, \*Enzymes, Oxidation reduction potential, Metabolism, Digestion, Fermentation, Degradation, Sampling, Filtration, Nitrogen fixing bacteria, Bacteria, Microorganisms, Carbohydrates, Biochemistry, Waste water treatment. Identifiers: Differentiation, Citric acid cycle, In-

6 different enzyme activities namely 6-PFK, LDA, M-1-PDH, 6-6-PDH, i CDH, and MDH were utilm-1-PDH, 0-0-PDH, 1 CDH, and MDH were unitated to differentiate among the following clostridium strains: (1) CE 30; (2) CE 3; (3) C.pasteurainum, (4) AB-6-7, (5) C.butyricum; (6) C.chauvoei; (7) C novyi, and (8) C. septicum. This differentiation was made possible by the fact that each strain shows characteristic enzymatic activity. Of the organisms studied, all contained 1-phosphofrutokinase (1-PFK); three lacked 6-PFK and mannitol 1-phosphate dehydrogenase. The hexose monophosphate shunt was present in 6 clostridia, determined by the presence of glucose 6-phosphate dehydrogenase. Clostridium septicum was the only organism studied which gave indications of pos-sessing the full critic acid cycle, with most of the other strains either the first of the four carbon part was only the active segments. The advanced detection methods have made differentiation of different strains by the enzymatic activity method a useful and accurate laboratory tool. (Lowry-Texas)

## RECOVERY OF MICA FROM SILT DEPOSITS IN THE NOLICHUCKY RESERVOIR, TENNES-

Bureau of Mines, Tuscaloosa, Ala. Tuscaloosa Metallurgy Research Center.
Ralph B. Adair, and Jerome O. Crabtree.

Bureau of Mines Report of Investigations RI 7488, Mar 1971. 9 p, 2 fig, 9 tab.

Descriptors: \*Reservoir silting, \*Mine wastes, \*Desilting, \*Silicates, \*Tennessee, Byproducts, Mining, Reservoirs, Dredging, Sedimentation, Mining, Reservoirs, Dredging, Seamentanes Mineralogy. Identifiers: \*Mica, \*Nolichucky reservoir (Tenn).

The Bureau of Mines conducted laboratory batch and small-scale continous tests on samples of silt from the Nolichucky Reservoir near Greenville. Tenn., to develop a process for the recovery of commerical-grade muscovite concentrates. Using a combination of Humphreys spirals for preconcentration followed by cationic flotation, 94.5% of the muscovite was recovered in a product containing 96.5% muscovite. Based on sedimentation soundings over the years, approximately 61.88 million cubic feet of mica-laden sediments lie above the present maximum pool level. Using the 61.88 million cubic feet and a measured average density of 75 pounds per cubic foot, this would indicate a minimum of 2.32 million tons of mica-bearing silt. Using 11% mica, as determined by average sample grade, this represents 255,200 tons of mica. It should be noted that the estimate is based on an average depth of 6.34 feet, whereas most of the deposits extend to depths of over 20 feet, and that deposits below the water line could not be sampled. (Woodard-USGS) W71-08523

#### THE EFFECT OF DETERGENTS ON GAS AB-SORPTION PROCESSES,

Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.

Jerry A. Caskey, Ralph F. Herbert, and Yan Pui

Available from the National Technical Information Available from the National Technical Information Service as PB-199 830, \$3.00 in paper copy, \$0.95 in microfiche. Water Resources Research Center Bulletin No 35, Apr 1971. 58 p, 20 fig, 36 ref, ap-pend. OWRR Project A-025-VA (2).

Descriptors: \*Surfactants, \*Absorption, \*Surface tension, \*Detergents, Carbon dioxide, \*Oxygena-

Identifiers: \*Interfacial resistance.

Although many studies have been made showing that surfactants can lower gas absorption rates the mechanism by which this occurs is not known. The purpose of this investigation was to show what effect the hydrophilic functional group has on gas absorption rates. Four different biodegradable surfactants were used. All four are used in commercial formulations. All four surfactants also had a linear hydrophobic group of 12 carbon atoms. In addition the position of the hydrophilic functional group was studied using 1-octanol and 4-octanol. Pure surfactants were used so that the interfacial resistance could be related to the surface concentration by means of Gibbs' adsorption isotherm. A quiescent liquid manometric gas absorption cell was used for the study. Carbon dioxide and water were used as the absorption system. Dodecyl sodium sulfate, dodecyl benzene sodium sulfonate, dodecyl diethanol amide and dodecyl diglycol amide were the four surfactants studied with different hydrophilic groups. The interfacial absorption resistance caused by the surfactant decreased with increasing molecular weight of the hydrophilic portion of the molecule. The interfacial resistance increased as the hydrophilic group moved from the end toward the center of the linear alkyl hydrophobic chain. (Caskey-VPI)

W71-08592

MARINE FOULING IN POWER STATIONS. Central Electricity Generating Board, Southampton (England). Marine Biological Lab. Nicholas Holmes.

Marine Pollution Bulletin, Vol 1 (NS), No 7, p 105-

106, July, 1970.

Descriptors: \*Chemcontrol, \*Fouling, \*Mussels, \*Cooling water, \*Chlorination, Invertebrates, Mollusks, Shellfish, Worms, Annelids, Tubificids, Environmental engineering, Thermal stress, Equipment, Water cooling, Water pollution sources, Inhibitors, Protective coatings, Chlorine, Treatment, Water flow

Identifiers: Barnacles, Hydroids, Balanus sp., Antifouling paint, Byssus threads.

The biological fouling problem in seawater coolant systems of electricity generating plants is briefly reviewed. Four preventative measures are discussed: periodic flushing with heated water, flushing with fresh water, use of antifouling paints, and continuous chlorination. The last is considered to approach the ideal as an industrial technique, because it is fairly cheap, is very effective, and has a minimal effect on the environment. (LeGore-Washington) W71-08598

#### MUSSEL FOULING IN CHLORINATED COOL-

ING SYSTEMS,
Central Electricity Generating Board, Southampton (England). Marine Biological Lab. N. Holmes.

Chemistry and Industry, p 1244-1247, 26 Sept, 1970. 8 fig, 2 ref.

Descriptors: \*Chemcontrol, \*Fouling, \*Mussels, \*Chlorination, \*Cooling water, \*Water flow, \*Inhibitors, Invertebrates, Mollusks, Shellfish, Environmental engineering, Equipment, Water cooling, Water pollution sources, Chlorine, Treatment, Biochemistry, Physiological ecology, Animal physiology, Environmental effects, Commercial shellfish, Industrial water.

Identifiers: \*Marine engineering, Power plant design, Byssus threads, Mytilus edulis.

The fouling problem presented by mussels in marine cooling water systems is discussed with emphasis on settlement and on byssus thread formation. The chlorinated cooling systems of two power stations are described, and mussel fouling within them is localized relative to water flow rates present. Both power plants are closed down for several hours each night, implying that the flow-dependent fouling patterns were due to differential removal of settled mussels as well as to differential obstruction of larval settlement. It is suggested that mussel control is accomplished in chlorine residuals of 0.5 mg/l at average water speeds greater than 1.5m/sec. This is attributed to partial interference of byssus thread formation by chlorine, resulting in the mussles' inability to effectively attach to the substrate. (LeGore-Washington) W71-08599

MERCURY CONTENT OF VARIOUS BOTTOM SEDIMENTS, SEWAGE TREATMENT PLANT EFFLUENTS AND WATER SUPPLIES IN WISCONSIN (A PRELIMINARY REPORT), Wisconsin Dept. of Natural Resources, Madison. For primary bibliographic entry see Field 05B. W71-08609

## TREATMENT OF AQUEOUS AGRICULTURAL WASTES FOR CLEAN WATER AND FOR MICROBIAL PROTEIN PRODUCTION,

Iowa State Univ., Ames. Dept. of Chemical Engineering. G. T. Tsao.

Available from the National Technical Information Service as PB-199 912, \$3.00 in paper copy, \$0.95

#### **Group 5D—Waste Treatment Processes**

in microfiche. Iowa State Water Resources Research Institute, Ames, Completion Report ISW-RRI-33, Engineering Research Institute ISU-ERI, Ames-99959 April, 1971, 34 p, 27 fig, 12 ref. OWRR Project A-032-IA (6).

Descriptors: Oxygen, Absorption, \*Foaming, \*Aeration, \*Cytological studies, Farm wastes, Waste water treatment, \*Biological treatment. Identifiers: Waldorf aerator, Cell growth, \*Whey.

Cheese whey containing 35,000 ppm BOD is the most concentrated liquid waste that can be found in large quantities. It foams excessively when bubbled with gas. Cheese whey was successfully treated in a Waldhof aerator by Saccharomyces fragilis. This yeast can reduce about 85% of the BOD and produce single cell protein. A batch as well as a continuous growth process of this yeast was successfully developed. A fundamental study on the transient and steady state behavior of cell growth was also conducted. Through computer simulation, it was possible to predict growth pattern in batch and continuous processes. Oxygen is important in any aerobic biological process. The Waldhof aerator not only provides good aeration for yeast growth, but is also capable of handling highly foamy liquors like whey through its foam recycling mechanism. A sysmetical study on the working mechanisms of a Waldhof aerator was conducted. Foam fractionation of the yeast and other microbiological cells was also studied. Foam decay was found to follow a second-order rate pattern. A theoretical investigation was conducted on gas-liquid interfacial oxygen absorption. The effect of viable microbiological cells that consume the transferring solute on the rate of oxygen absorption was analyzed. W71-08661

DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS--PART 2, American Water Works Association Research Foundation, New York.

For primary bibliographic entry see Field 05F. W71-08672

BIOLOGICAL AND CHEMICAL TREATMENT OF INDUSTRIAL WASTES, EIMCO Corp., Salt Lake City, Utah.

D. A. Dahlstrom, L. D. Lash, and J. L. Boyd. Chemical Engineering Progress, Vol 66, No 11, p 41-48, 1970. 6 fig, 5 tab, 6 ref.

Descriptors: \*Water reuse, \*Biological treatment, \*Industrial wastes, Water pollution control, Sewage treatment, Waste water treatment, Solid wastes, Biochemical oxygen demand, Phosphates, Nitrogen, Suspended load, Chemical precipitation, Byproducts, Waste treatment, Chemical oxygen demand, Hydrogen ion concentration, Activated sludge, Aeration, Pilot plants, Toxicity, Effluents, Cooling towers, Solids contact process, Recirculated water, Beneficial use, Filtration, Irrigation, Dewatering, Oxygen, Economics, Colorado. Identifiers: Colorado Springs (Colo), Recycled

In treating waste water, characterization of raw waste is necessary to set process conditions near optimum. A biological seed acclimated to the waste tested is necessary; nitrogen and phosphorus are essential in minimum quantities, which are conveniently added at the same time as the feed: oxygen is also required. Many chemicals such as lime, iron, and aluminum salts, as well as the newer polyelectrolytes, have shown a striking ability to coagulate finely divided colloidal solids; various natural coagulants have shown similar properties. Since biological treatment of vinyl resin wastes was inadequate to meet regulatory requirements, chemical treatment was also used. The combined biological and chemical treatments removed 97% of the biochemical oxygen demand, and suspended solids resulting in effective treatment of raw waste. Aeration equipment, solids-contact equipment, gravity clarification, dissolved air flotation, granular media filtration and sludge dewatering are calculated and described. Reuse of treated waste water to meet requirements is often economical. Two examples of water reuse and reclamation are given. By-product recoveries may represent substantial credit to the overall costs. Recovery of coal and of spent grains for animal feed or protein for human consumption in the brewery industry are examples. (Jones-Wisconsin)

WASTE WATER CONTROL FACILITIES IN A PETROCHEMICAL PLANT, Union Carbide Corp., South Charleston, W. Va.; and Union Carbide Corp., Ponce, Puerto Rico. J. E. Rucker, and R. W. Oeben.

Chemical Engineering Progress, Vol 66, No 11, p 63-66, 1970. 1 fig, 3 tab, 2 ref.

Descriptors: \*Waste water treatment, \*Construction costs, \*Chemical wastes, Industrial plants, Water pollution control, Design criteria, Personnel, Equipment, Industrial wastes, Puerto Rico. Identifiers: \*Petrochemical wastes, Union Carbide Corporation, Ponce (Puerto Rico), Waste loads.

The Union Carbide Corporation's petrochemical plant addition at Ponce, Puerto Rico, is planned to include installation of a primary and secondary biological treatment plant for waste water from both existing and new facilities. New facilities contain equipment for recycle and product recovery. Engineering efforts to further minimize waste effluents continue through all phases of design for each production unit and operation of the new units. Aqueous pollution control represents a total investment of \$12.8 million. Operating pollution control personnel, training, and design criteria are tabulated. Methods used for determining waste loads and process design of the terminal facilities, including instrumentation and control procedures, are described. Determination of total waste water load was based on flow measurement and laboratory analysis of waste streams from the existing plant plus estimates of aqueous waste loads from new units. Waste water load removal design was planned to avoid taking waste streams into the ter-minal treatment plant without first investigating known alternative disposal methods. The sewer system is designed to segregate storm or fire water from process waste water streams. Monitoring is provided at the treatment facilities by an operator on duty around-the-clock. (Auen-Wisconsin) W71-08676

FEASIBILITY OF ALTERNATIVE MEANS OF COOLING FOR THERMAL POWER PLANTS NEAR LAKE MICHIGAN.

Federal Water Quality Administration, Corvallis, Oreg. Pacific Northwest Water Lab.

Department of the Interior, Federal Water Quality Administration, Aug 1970. 112 p, 4 fig, 38 tab, 73

Descriptors: \*Feasibility studies, \*Water cooling, \*Thermal powerplants, \*Lake Michigan, Economic feasibility, Technical feasibility, Environmental effects, Ponds, Canals, Condensation, Cooling towers, Evaporation, Costs. Identifiers: \*Waste heat, Cooling systems.

The feasibility was evaluated of dissipating waste heat from thermal power plants located near Lake Michigan. Consideration was given to the following methods: evaporative towers with either mechanical or natural draft, cooling ponds, spray cooling canals, and dry cooling towers with either natural or mechanical draft. The study area, Lake Michigan, was subdivided into four sections to compensate for the effect of climatic conditions. The analysis of meteorological, economic, engineering, and environmental aspects indicated that any of the investigated cooling systems are feasible alternatives for power plants on Lake Michigan. The maximum economic penalty of 9-10% was for dry towers, whereas the minimum of about 1%--for cooling ponds and spray canals. (Wilde-Wisconsin)

METHODS FOR SEPARATION OF BDEL-LOVIBRIO FROM MIXED BACTERIAL POPU-LATION BY FILTRATION THROUGH MIL-LIPORE FILTERS OR BY GRADIENT DIF-FERENTIAL CENTRIFUGATION,

Hebrew Univ., Jerusalem (Israel). Dept. of

For primary bibliographic entry see Field 05A. W71-08729

STUDY OF THE FILTER ACTIVITY OF CERTAIN MARINE ANIMALS (SALPA, CIONA, AMPHIOXUS) WITH RESPECT TO LABELLED BACTERIA, COMPARED TO THE ACTIVITY OF CERTAIN EDIBLE MOLLUSKS, (ETUDE DE CERTAINS MOLLUSQUES COMESTIBLES

OF CERTAINS ANIMAUX MARINS (SALPA, CIONA, AMPHIOXUS) A L'EGARD DE BACTERIES

MARQUEES, COMPAREE A L'ACTIVITE DE

CERTAINS MOLLUSQUES COMESTIBLES (MYTILUS, TELLINA)),

Naples Univ. (Italy). Instituto di Igiena. For primary bibliographic entry see Field 05C.

OIL POLLUTION DEFENSE SYSTEM.

Harding Pollution Control Corp., West Hempstead,

For primary bibliographic entry see Field 05G. W71-08758

BUILDING RELIABILITY OF PLANT, PEOPLE.

Detroit Metropolitan Water Services, Mich.

Gerald Remus.

Journal American Water Works Association, Vol. 62, p 38-40, Jan 1970. 3 tab.

Descriptors: Reliability, Population, Water quality, Water supply, Manpower, Training, \*Costs, Financing, Social change, Construction, Administration, Water pollution control, \*Treatment facilities, Water reuse, Cities, Michigan.
Identifiers: \*Water utility, Metropolitan-areawide

utility, Routine system expansion, Political involve-ment, Revenue bonds, WWP formula, Detroit (Mich).

Reliable operation of a wide-area system does not happen by chance. Although all problems cannot be foreseen, certain operational, personnel, and fiscal policies can be adopted to enhance the reliability factor. This article discussed some of many major difficulties foreseen in water system development. Tabulated data included water revenue dollar distribution, capacity and cost of Detroit's water treatment plants, and growth of Detroit system assets and indebtedness. Total reliability - of our people, our systems, and our public acceptance - can be accomplished for individual systems and for the industry if we develop the people to do the job properly, with the highest professional conduct; if we develop our systems with emphasis on all engineering aspects, rather than on supply alone; if we abandon provincialism; and if we move with, rather than react against, changing social and technical changes, then our leadership will be apparent and public acceptance will be wholehearted. (Wang-Rutgers) W71-08816

RISK EVALUATION IN SEWAGE TREATMENT PLANT DESIGN, Cornell Univ., Ithaca, N.Y.

D. P. Loucks.

Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 93, No SA1, p 25-39, Feb 1967. 9 fig.

### Water Treatment and Quality Alteration—Group 5F

Descriptors: \*Risks, \*Evaluation, \*Sewage treatment, Stochastic process, Construction costs, Efficiencies, Effluents, Basins, BOD, Benefits, Probabilities, Storage capacity, Standards, Frequency, \*Treatment facilities, Dissolved oxygen, Waste water treatment, Waste assimilative capacity,

Water quality.
Identifiers: \*Random variable, Serial correlation, Cross correlation, Operating policy, Probabilistic

This analysis was an application of some probability theory and computer programming to determine the design and operating criteria of a minimumcost waste water treatment facility that meets a probabilistic or deterministic stream quality stan-dard. A probabilistic model was developed and solved to determine the cumulative probability distributions of minimum DO concentrations for various consecutive-day periods downstream from any particular waste water treatment plant. The proba-bilistic model was discussed. An outline of the computer flow diagram used for the solution of the model was presented. An example was shown and the results of this example were discussed. If an efficiency was specified for a particular plant, whether optimally or not, the model could be used to predict the risks of standard violation and to determine the effectiveness of effluent storage in reducing this risk as well as the cost of waste water treatment. (Wang-Rutgers)
W71-08819

# DEVELOPING RURAL HOME WATER SUP-

Albert A. Cannella.

Journal of Soil and Water Conservation, Vol 26, No 1, p 30-31, Jan - Feb 1971. 2 figures, 1 table.

Descriptors: \*Water quality control, \*Cost comparisons, Initial costs, \*Treatment facilities, Rural

Identifiers: \*Putnam County Soil Conservation Dis-

The author describes the economic and construction details of building a surface water supply for an individual in a rural area. The author explains that in areas where groundwater is highly contaminated by chemicals the cost of this system compares favorably with other types of rural water supply. The filtration system that he describes is a smallsale replica of a municipal treatment facility with an initial cost of approximately \$1500. (Holmes -Rutgers) W71-08823

### FACTORS INFLUENCING PHOSPHOR REMOVAL BY BIOLOGICAL TREATMENT, **PHOSPHORUS** Sanitary Engineering Center, Cincinnati, Ohio.

Robert L. Bunch.

Chemical Engineering Symposium Series, Water - 1970, Vol 67, No 107, p 90-94. 3 tab, 33 ref.

Descriptors: \*Nutrients, \*Phosphorus, Anaerobic digestion, Sewage effluents, Eutrophication, \*Biological treatment, Waste water treatment, Phosphates, Nutrient requirements.

Conventional biological treatment, as practiced today, does not effectively remove nutrients from waste water. The influence of increased use of phosphates, digester recycle, and imbalance of nutrients in waste water is discussed. Phosphorus removal by synthesis can be higher than normally encountered if digester supernatant is not recycled and primary clarification is eliminated. The elimination of these two practices will increase the carbon to phosphorus ratio, thereby tending to correct the nutrient imbalance. (Bunch-EPA)

# COMBINED BIOLOGICAL AND CHEMICAL TREATMENT FOR PHOSPHORUS REMOVAL, Advanced Waste Treatment Research Program,

Cincinnati, Ohio.
Michael C. Mulbarger, and Donald G. Shifflett.

Chemical Engineering Progress Symposium Series, Vol 67, No 107, p 107-116, 1970. 13 fig, 3 tab, 19 ref. FWQA Contract WA66-19.

Descriptors: Waste water treatment, \*Activated sludge, \*Chemical precipitation, \*Phosphorus, \*Aluminum, Biological treatment, Sludge. Identifiers: \*Alum, \*Aluminate, Suspended solid.

Liquid alum and sodium aluminate were utilized for phosphorus removal at 1.0 and 0.2 million gal/day activated sludge municipal waste water treatment plants. Phosphorus removals were determined at aluminum to phosphorus ratios up to a limiting point which exhibited a minimum total soluble phosphorus residual of about 1.0 mg/liter. More efficient use of chemical and higher phosphorus removal efficiencies are obtained in a multistage activated sludge system. The type of activated sludge system also influenced chemical phosphorus removals. Excessive effluent suspended solids were found to be more a function of the volatile solids produced to aluminum added ratio than of exceeding a given aluminum to phosphorus ratio or aluminum dosage. The added chemical serves as a weighting agent in the activated sludge and fully compensates for the additional solids mass to be handled both in terms of system hydraulics and solids handling. Batch studies indicate that aluminum as alum will outperform iron as ferric chloride on a performance/cost basis and that the best point of addition is just before solids-liquid separation. The considerations involved in this type of phosphorus removal system are discussed. (Mulbarger-EPA)

### CASE STUDIES OF MUNICIPAL WASTE DISPOSAL SYSTEMS,

Bureau of Mines, Pittsburgh, Pa. Eastern Field Operation Center.

For primary bibliographic entry see Field 05E. W71-08907

### 5E. Ultimate Disposal of Wastes

DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS--PART 2,

American Water Works Association Research Foundation, New York.

For primary bibliographic entry see Field 05F. W71-08672

### OCEAN POLLUTION AND MARINE WASTE DISPOSAL.

For primary bibliographic entry see Field 05B.

## SUMMARY OF FINDINGS ON SOLID WASTE DISPOSAL SITES IN NORTHEASTERN IL-LINOIS.

Illinois State Geological Survey, Urbana. For primary bibliographic entry see Field 05G.

# CASE STUDIES OF MUNICIPAL WASTE

DISPOSAL SYSTEMS,
Bureau of Mines, Pittsburgh, Pa. Eastern Field Operation Center.

H. W. Sheffer, E. C. Baker, and G. C. Evans. Bureau of Mines Information Circular 8498, 1971. 36 p, 14 fig, 19 ref.

Descriptors: \*Waste disposal, \*Municipal wastes, \*Waste treatment, \*United States, \*Reviews, Methodology, Sanitary engineering, Landfills, Hydrology, Water pollution, Path of pollutants, Hydrology, Water pollution, Path of pollutants, Mine wastes, Geology, Groundwater, Water quality, Compaction, Compressibility, Solid wastes, Incineration, Percolation, Seepage. Identifiers: \*Landfill hydrology.

Technical and economic aspects of community refuse disposal systems and their effects on the en-

vironment are identified and described. Seven landfills and two incineration systems, located throughout the United States, are reviewed. For example, a solid wastes landfill stabilization project conducted for the city of Santa Clara, Calif., proved that aeration of sanitary landfills provides more rapid stabilization, greater refuse density fol-lowing compaction, the conservation of landfill space, and elimination of vermin and bacteria by high-temperature oxidation. (Woodard-USGS) W71-08907

### 5F. Water Treatment and **Quality Alteration**

#### MARINE FOULING IN POWER STATIONS,

Central Electricity Generating Board, Southampton (England). Marine Biological Lab. For primary bibliographic entry see Field 05D. W71-08598

### MUSSEL FOULING IN CHLORINATED COOL-ING SYSTEMS,

Central Electricity Generating Board, Southampton (England). Marine Biological Lab. For primary bibliographic entry see Field 05D. W71-08599

# DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS--PART 2,

American Water Works Association Research Foundation, New York.

Harry A. Faber, and Kitty C. Klomp. Journal American Water Works Association, Vol 61, No 11, p 619-638, 1969.

Descriptors: \*Waste water treatment, \*Waste disposal, \*Water works, \*Water treatment, Water softening, Chemical precipitation, Sludge, Dialysis, Coagulation, Freezing, Centrifugation, Brine disposal, Cation exchange, Separation techniques, Water pollution, Ultimate disposal, Costs, Sludge disposal, Sludge treatment, Legislation.

Identifiers: Alum sludge, Sanitary sewers, Vacuum filtration, Sand bed, Wedge wire drying, Filter pressing, Softening sludge, Reclaiming lime, Washwater wastes.

Current information on and improved techniques to solve the problems of water treatment plant waste disposal and regulatory aspects are given. Since alum is prime coagulant in U S water plants, disposal of sludge is of primary consideration. Discharge of water treatment plant wastes directly to surface waters is impractical. Among various methods of water treatment waste disposal discussed are lagoons, discharge to sanitary sewers, a freezing process (operated in the United Kingdom), the advantages of the centrifuge method, vacuum filtration, sand drying beds, treatment by filter pressing, larging to seas, pipeline transport, and cost of alum recovery. Disposal of filter washwater, disposal of sludge from softening plants, including lagoon treatment, sewer discharge, and lime reclamation, together with disposal of brines are also deliberated, together with the status of plant operation and regulatory aspects. (Jones-Wisconsin) W71-08672

# PROBABILITY THEORY AS AN AID TO RESEARCH PLANNING, Wisconsin Univ., Madison. Dept. of Civil Engineer-

For primary bibliographic entry see Field 06A.

### BACTERIOLYTIC STOCK IN SEAWATER, (SOURCES BACTERIOLYTIQUES DANS L'EAU

Naples Univ. (Italy). Instituto di Igiena. E. Campanile, V. Ferro, E. DeSimone, S. Grasso, and R. DeFusco.

# Field 05-WATER QUALITY MANAGEMENT AND PROTECTION

# Group 5F-Water Treatment and Quality Alteration

Revue International d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Institut National de la Sante et de la Recherche Medicale, Fondation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 117-

Descriptors: Water pollution control, \*Self-purification, \*Bacteria, Sea water, Water treatment,

Micro-organisms.
Identifiers: \*Lytic strains, \*Bdellovibrio bacteriovorus.

Bacteriological research on Bdellovibrio bacteriovorus in sea water indicated, with some frequency and constancy, the presence of colonies which can bring on the lysis of some test bacteria. This phenomenon and its possible intervention in self-purification led to further studies on the nature of lytic strains and their capabilities in self-purification. Research of lytic strains is much easier when the culture medium is low in nutrients. Temperature, nature and way of innoculation of test-bac-teria influence the test value. The time parameter is variable from one strain to another and is also variable within each individual strain. Isolated lytic strains showed a certain preference for gram-positive terrestrial germs, however, some act against both gram-negative and gram-positive bacteria. (Ensign-PAI) W71-08732

RESEARCH OF THE BDELLOVIBRIO BACTERIOVORUS IN THE SEA, RIVERS AND SEWAGE WATERS, RECHERCHE DU BDELLOVIBRIO BACTERIOVORUS DANS LA MER, LES FLEUVES ET LES EAUX D'EGOUT,

Naples Univ. (Italy). Istituto di Igiena. V. Ferro, E. DeSimone, E. Campanile, R. DeFusco,

and S. Grasso.

Revue Internationale d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Institut National de la Sante et de la Recherche Medicale, Foundation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 109-

Descriptors: \*Self-purification, \*Bacteria, Water pollution control, Seawater, Fresh water, Sewage, Pathenogic bacteria, Water treatment. Identifiers: \*Bdellovibrio bacteriovorus, \*Sal-

monella typhi, \*Pseudomonas aeruginosa.

The role of Bdellovibrio bacteriovorus in the process of self purification in sea water, fresh water and sewage water was studied. Test-germs used were Salmonella typhi (Vi strain) and Pseudomonas aeruginosa. B. bacteriovorus was found to be more frequent after samples were enriched with the host bacteria and was more abundant in sewage than fresh water and least abundant in sea water. Lytic action of B. bacteriovorus in relation to P. aeruginosa is discussed. Epidemiological aspects in studying the action of B. bacteriovorus on certain gram negative germs, pathogens towards man, are considered. (Ensign-PAI) W71-08733

VIABILITY OF ENTAMOEBA HISTOLYTICA CYSTS EXPOSED TO SEA WATER,

Technion - Israel Inst. of Tech., Haifa (Israel). Sanitary Engineering Labs.

For primary bibliographic entry see Field 05B. W71-08735

DISTRIBUTION OF SOME PARASITIC GERMS AND PATHOGENIC BACTERIA IN WORLD-WIDE WATERS, (DISTRIBUTION DES GERMES PARASITES DES BACTERIES PATHOGENES DANS LES EAUX MONDIALES), Institut Pasteur, Paris (France); Murmanskaya Biologicheskaya Stantsiya (USSR); and Akademiya Nauk SSSR, Leningrad. Zoologicheskii Institut.

For primary bibliographic entry see Field 05B. W71-08736

BIOLOGICAL FACTORS OF SELF-PURIFICA-TION OF SEA WATER: CLEAR AND OBSCURE POINTS OF A DEBATABLE QUESTION, (FAC-TEURS BIOLOGIQUES D'AUTOEPURATION DES EAUX DE MER: POINTS CLAIRS ET POINTS OBSCURS D'UNE QUESTION DISCU-

TEE), Naples Univ. (Italy). Istituto di Igiena. For primary bibliographic entry see Field 05G. W71-08738

### 5G. Water Quality Control

PIPELINE FLOW OF SOLIDS-LIQUID SUSPEN-SIONS.

Syracuse Univ., N. Y. For primary bibliographic entry see Field 05D. W71-08397

FIRST NATIONAL SYMPOSIUM ON FOOD PROCESSING WASTES PROCEEDINGS. For primary bibliographic entry see Field 05D.

WURDD'S TASK FORCE ON AGRICULTURAL

POLLUTION, Agricultural Research Service, Albany, Calif. Western Utilization Research and Development

For primary bibliographic entry see Field 05D. W71-08415

GUIDELINES--WATER QUALITY MANAGE-MENT PLANNING.

Environmental Protection Agency, Washington,

D.C. Water Quality Office. For primary bibliographic entry see Field 06E. W71-08427

WATER QUALITY CONTROL IN CALIFORNIA: A REGIONAL APPROACH.

For primary bibliographic entry see Field 06E.

A BILL TO AMEND THE CLEAN AIR ACT AND THE FEDERAL WATER POLLUTION CONTROL ACT TO PROVIDE FOR STANDARDS FOR THE MANUFACTURE OF CERTAIN PRODUCTS TO PROTECT THE QUALITY OF THE NATION'S AIR AND NAVIGABLE WATERS.

For primary bibliographic entry see Field 06E. W71-08429

FIRST ANNUAL REPORT ON THE STATE OF THE NATION'S ENVIRONMENT--MESSAGE FROM THE PRESIDENT OF THE UNITED STATES,

For primary bibliographic entry see Field 06E. W71-08431

SANTA BARBARA CHANNEL OIL LEASES, For primary bibliographic entry see Field 06E. W71-08437

THE FLORIDA WATER POLLUTION CON-TROL AND SEWAGE TREATMENT PLANT GRANT ACT OF 1970.

For primary bibliographic entry see Field 06E. W71-08441

PUBLIC HEALTH ASPECTS OF INDIVIDUAL WATER WELLS.

Monroe County Health Dept., Mich. J. C. Hancock.

Groundwater, Vol 1, No 3, p 27-29, July 1963. 1 tab, 4 ref.

Descriptors: \*Water wells, Water \*Michigan, \*Public health, \*Standards, Water pol-

Identifiers: Water well construction code, Shigella infections, Shallow wells.

Local government in Michigan, and perhaps in other states, must try to bring the best thinking there is concerning solutions to health problems which are within their legally designated area of responsibility. One such local health department activity in Michigan is the construction and operation of private individual water well systems. Monse Courty, which is just beginning to feel the eftion of private individual water well systems. Moli-roe County, which is just beginning to feel the ef-fects of the suburban spillover from Detroit, Michigan, and Toledo, Ohio, recognized, in 1961, the need for regulation of such water well systems. The need for regulation of such water well systems. The subsequent development of a Code, and its enforcement have made us realize that we are just beginning to fully understand a subject which is much broader in scope from a public health standpoint than just construction details and bacterial tests. (Campbell-NWWA)

HYDRODYNAMICS AND DISCHARGE MEA-SUREMENTS OF STORM SEWERS,
Rutgers - The State Univ., New Brunswick, N. J.

Water Resources Research Inst. For primary bibliographic entry see Field 08B. W71-08496

LAKE AND RIVER POLLUTION, AN ANNOTATED BIBLIOGRAPHY,

For primary bibliographic entry see Field 05B. W71-08498

WATER QUALITY MANAGEMENT AND A POLICY MODEL,
Clemson Univ., S. C. Dept. of Environmental Systems Engineering; and Georgia Inst. of Tech., Atlanta. School of Industrial and Systems En-

Atlanta. Georgia Action of the Action of the

Descriptors: \*Dynamic programming, \*Water quality control, \*Optimization, \*Costs, \*Waterpolicy, \*Organic wastes, \*Temperature, Dissolved oxygen, River basins, Biochemical oxygen demand, Resource allocation.

Interrelated quality characteristics for a river basin were considered in the formulation of a dynamic programming model to minimize total cooling and treatment costs. The specific water quality parameters selected for study were dissolved oxygen and temperature which were affected principally by organic and thermal wastes, respectively. A sketch of a generalized river basin was shown and then shown again as a series of discrete reaches. It was necessary to consider three system boundaries: (a) the upstream limit of the system, (b) the downstream limit of the system, and (c) boundaries of individual reaches between (a) and (b). The problem was formulated as a resource allocation problem where the resource being allocated was the natural capacity of a stream to assimilate thermal and organic waste and then as an initial-value dynamic programming problem. Temperature, temperature rise, and dissolved oxygen were constrained at each stage. The cost functions for both cooling and treatment were well behaved, and constraints were such that the feasible regions were reduced significantly. It was noted that this model should be useful in evaluating the effects of the location of another waste source on a river. (Kriss-Cornell) W71-08499

FLORIDA AQUATIC WEED CONTROL ACT. For primary bibliographic entry see Field 06E. W71-08502

### Water Quality Control—Group 5G

ROLE OF MICROORGANISMS GROWING ON OIL IN THE SELF-CLEANING AND INDICATION OF OIL POLLUTION IN THE SEA, For primary bibliographic entry see Field 05A W71-08503

STUDIES OF OIL RETENTION BOOM HYDRODYNAMICS,

Hydronautics, Inc., Laurel, Md.
William T. Lindenmuth, E. R. Miller, Jr., and C. C.

Available from the National Technical Information Service as AD-719294, \$3.00 in paper copy, \$0.95 in microfiche. Coast guard Contract DOT-CG-00-

Descriptors: \*Water pollution, \*Oil wastes, Shear

Identifiers: Containment, \*Hydrodynamics, Mode tests, Oil spills, Oil booms.

Results of an experimental investigation of oil containment hydrodynamics are presented with theoretical analyses to help explain the experimental findings. Two-dimensional model tests were performed using several petroleum products including diesel fuel and motor oil. Test variables in addition to oil properties were current, interfacial tension, gravity waves, slick volume, containment boom geometry, and boom depth. Also studied were three-dimensional effects and the efficiency of using absorbent additives and multiple boom configurations as containment aids. W71-08511

RECOVERY OF MICA FROM SILT DEPOSITS IN THE NOLICHUCKY RESERVOIR, TENNES-SEE,

Bureau of Mines, Tuscaloosa, Ala. Tuscaloosa Metallurgy Research Center.

For primary bibliographic entry see Field 05D. W71-08523

A CONSIDERATION OF FEDERAL FINANCIAL INCENTIVES TO INDUSTRY FOR ABATING WATER POLLUTION.

League of Women Voters, Washington, D.C.

Current Review of Water Resources, No 3, League of Women Voters of the US, Washington, DC, Aug 1966. 20 p, 9 ref.

Descriptors: \*Water pollution control, \*Industrial wastes, \*Pollution abatement, \*Taxes, Financing, Federal project policy, Industrial plants, Pollutants Federal government, Feasibility studies, Water quality, Water quality control, Tax rate, Economic feasibility, Waste disposal, Waste treatment, Efluents, Treatment facilities, Water pollution sources, Water pollution treatment, Legal aspects, Administration.

Identifiers: \*Economic incentives.

Noting the recent intensification of interest in industrial water-pollution abatement, this publication considers alternative federal programs to provide industry with financial incentives to abate water pollution. The article examines: (1) financial incentives proposed in Congress, (2) tax preferences relating to marginal companies, (3) reasons supporting tax preferences, (4) opposition to tax preferences, (5) alternatives to tax preferences, and (6) questions for citizens to consider. The evaluation focuses primarily upon external, 'carrottype' tax incentives. The merits and relative impact of accelerated depreciation methods and investment tax credits are considered. Six arguments supporting tax incentives are presented, and ten arguments in opposition are listed. User charges, reflecting the burden imposed on the community, and effluent charges, covering all damages result-ing from industrial wastes, are evaluated as 'sticktype' alternatives to tax preferences. In conclusion, a series of nine questions as to who will pay for industrial water-pollution abatement are presented, along with a list of nine informational publications available to laymen. (Earl-Florida)
W71-08529 SYMPOSIUM ON MULTIPLE-SOURCE URBAN DIFFUSION MODELS

For primary bibliographic entry see Field 05B.

GROUNDWATERS OF MAGNESITE KARST IN CZECHOSLOVAKIA (GERMAN: UNTERIR-DISCHE WASSER DES MAGNESITKARSTES

IN DER CSSR),
For primary bibliographic entry see Field 02F.
W71-08576

A BILL TO AMEND THE OIL POLLUTION ACT TO IMPLEMENT THE PROVISIONS OF THE INTERNATIONAL CONVENTION FOR THE PREVENTION OF THE POLLUTION OF THE SEA BY OIL.

For primary bibliographic entry see Field 06E. W71-08578

ACID MINE DRAINAGE FORMATION AND

Ohio State Univ., Research Foundation, Columbus,

Available from the National Technical Information Service as PB-199 835, \$3.00 in paper copy, \$0.95 in microfiche. Water Pollution Control Research Series, DAST-42, Apr 1971. 82 p, 7 fig, 69 ref. EPA Program 14010 FPR-04/71.

Descriptors: \*Acid mine water, \*Pyrite, \*Oxidation, \*Pollution abatement, Ferrobacillus, Underground streams, Mine wastes, Water pollution control, \*Mine drainage, Mining, Iron bacteria, Chemical reactions, Kinetics.

This report pertains to at-source control of pyrite oxidation. The current level of knowledge of acid mine drainage formation is critically reviewed, with emphasis on reaction kinetics and reactant and product transport. A reaction system model is developed which provides a conceptual framework for subsequent discussion dealing specifically with the physical, chemical, and biological charac-teristics of pyritic systems encountered in mining situations. Practical considerations of at-source control of acid mine drainage formation in underground mines, spoil banks, and refuse piles are presented in the final section. Deficiencies in current knowledge include: Descriptions of the physical environment existing at pyrite oxidation sites in natural systems are far more incomplete that the current understanding of pyrite oxidation kinetics; oxygen transport is poorly described at this time, but is probably the rate-controlling factor in most instances; serious questions exist as to the effectiveness of air-sealing techniques as currently prac-ticed; the significance of bacterial catalysis of pyrite oxidation under field conditions has not been W71-08591

EFFECTS OF ARTIFICIAL DESTRATIFICA-TION ON DISTRIBUTION OF BOTTOM ORGANISMS IN EL CAPITAN RESERVOIR, California State Dept. of Fish and Game, Sacra-

mento. Inland Fisheries Branch.

Alex Calhoun, Paul Hubbell, and Arlow Fast. California Department of Fish and Game, Fish Bulletin 148, 1970. 30 p, 17 fig, 5 tab, 24 ref.

Descriptors: \*Aquatic habitats, \*Biomes, \*Ecological distribution, \*Stratification, \*Dissolved oxygen, \*Hypolimnion, \*Limiting factors, Ecology, Environmental gradient, Distribution patterns, Food webs, Dominant organisms, Niches, Thermal stratification, Epilimnion, Reservoirs, Spatial distribution, Benthic fauna, Clams, Oligochaetes, Diptera, Nematodes, Invertebrates, California

Identifiers: \*Artificial enhancement, Enhancement, Destratification, Midge larvae, El Captian

The bottom fauna of El Capitan Reservoir, San Diego County, California, was sampled during

1964, under normal conditions, which included prolonged stratification. The lake was then destratified artificially by injection of compressed air for two years. The benthic organisms rapidly invaded the profundal zone, in which they had previously been absent. Their total numbers in the lake increased dramatically. A combination of anoxia and toxicity in the hypolimnion had presumably excluded them from the deeper parts of the lake when it was stratified. In 1967 the lake was permitted to stratify again. By August the normal summer distributional pattern of bottom organisms was tributional pattern of bottom organisms was beginning to re-appear. Extending the distribution of midges throughout the lake by artificial destratification should increase the amount of flood available to game fish. The long term implications of artificial destratification for reservoir fishery management are discussed. (LeGore-Washington)

ENVIRONMENTAL PROTECTION--TVA EX-

PERIENCE, Tennessee Valley Authority, Chattanooga. For primary bibliographic entry see Field 06G. W71-08640

RESULTS OF FIELD INVESTIGATIONS OF VELOCITIES OF WATER MOVEMENT IN COOLING RESERVOIRS,

For primary bibliographic entry see Field 08B. W71-08641

GROUND WATER SAFETY EVALUATION -

PROJECT GASBUGGY,
Teledyne Isotopes, Polo Alto, Calif. Palo Alto Labs.

Available from NTIS PNE-1009, PNE-1009, Mar 12, 1971. 38 p, 5 fig, 10 tab, 13 ref. AEC Contract AT (29-2)-1229.

Descriptors: \*Groundwater movement, \*Permeability, \*Sandstones, \*Radioisotopes, Nuclear explosions, Excavation, Natural gas, Soil contamination, Water pollution, Strontium radioisotopes,

Identifiers: Cesium radioisotopes.

Groundwater in the Ojo Alamo Sandstone could mix with other water along the San Juan River near the mouth of Los Pinos River, 38 kilometers northwest of the Gasbuggy site. However, based on available data, it will take 5900 years for the groundwater at the Gasbuggy site to flow to this point. Within 309 years tritium will decay below the appripriate concentration guide (CG) for the general public. Strontium-90 and cesium-127 will migrate no farther from the cavity than 320 meters and 3.5 meters, respectively, in 1000 years, and by this time both nuclides will have decayed to well below the CG. (Bopp-ORNL) W71-08652

DETERMINATION OF THE FEASIBILITY OF REMOVAL OF ALGAL NUTRIENTS IN LAKE WATER BY ION EXCHANGE,

Massachusetts Univ., Amherst. Water Resources Research.

Available from the National Technical Information Service as PB-199 914, \$3.00 in paper copy, \$0.95 in microfiche. Water Resources Research Publication No 12 (undated). 64 p, 13 fig, 14 tab, 45 ref. OWRR Project A-018-MASS (2).

Descriptors: \*Eutrophication, \*Ion exchange, \*Phosphorus, \*Theoretical analysis, \*Anion exchange, Chlorides, Sulfates, Separation techniques, Lakes, Nutrients, Reservoirs, Resins, Phosphates, Fresh water. Identifiers: Phosphate removal, Valency.

Excessive amounts of phosphorus, introduced by the activities of man, contribute to the accelerated

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eutrophication experienced in many of our natural waters. The feasibility was studied of using ion exchange techniques, perhaps in a new way, to effect a reduction in the phosphorus levels of natural waters. A study of the ion exchange characteristics waters. A study of the ion exchange characteristics of phosphate species in the presence of chloride as a competing ion was completed. A similar study using sulfate as the competing ion is nearing completion at the present time and is briefly discussed. Over the pH range of natural waters, the phosphate species undergoing exchange is HPO sub 4 2-. With chloride as the competing ion the bettersteady that the property of the pro electroselectivity principle applies; with sulfate a similar phenomenon occurs due to the base strength of the HPO sub 4 2- ion. Kinetic studies of the exchange process indicate that it is the HPO sub 4 2- ion concentration which is rate controlling and this ion migrates through the resin-solution inand this for infigrates unrough the resin-solution in-terface. Ion exchange removal of phosphate from natural waters is feasible and should be investigated further with field studies. (Wilde-Wisconsin) W71-08669

#### WARM WATER UTILIZATION,

Oregon State Univ., Corvallis. Dept. of Soils For primary bibliographic entry see Field 03C. W71-08671

HILL V CITY OF WINTERSET (DAMAGES FOR CITY'S MAINTENANCE OF NUISANCE). For primary bibliographic entry see Field 06E. W71-08678

CONTINUOUS SYSTEM MODELS OF OXYGEN DEPLETION IN A EUTROPHIC RESERVOIR, Oklahoma State Univ., Stillwater. Dept. of Chemis-

For primary bibliographic entry see Field 06A. W71-08684

STOVERN V TOWN OF CALMAR (MEASURE OF WATER POLLUTION DAMAGES TO LESSOR OF RIPARIAN LAND).

For primary bibliographic entry see Field 06E. W71-08689

STOVERN V TOWN OF CALMAR (ABATEMENT OF WATER POLLUTION NUISANCE THROUGH CONSTRUCTION OF SEWAGE DISPOSAL SYSTEM).

For primary bibliographic entry see Field 06E. W71-08692

RESOURCES: CONSERVATION AND MANAGEMENT.

Department of Defense, Washington, D.C. For primary bibliographic entry see Field 06E. W71-08695

STATE TAX INCENTIVES TO FIGHT POLLU-TION,

For primary bibliographic entry see Field 06E. W71-08696

CONTINENTAL SHELF OIL DISASTERS: CHALLENGE TO INTERNATIONAL POLLU-TION CONTROL,

For primary bibliographic entry see Field 06E. W71-08697

FOREWORD TO SYMPOSIUM--LAW AND THE ENVIRONMENT,

For primary bibliographic entry see Field 06E. W71-08698

LEGISLATION AND THE ENVIRONMENT: IN-DIVIDUAL RIGHTS AND GOVERNMENT AC-COUNTABILITY,

For primary bibliographic entry see Field 06E. W71-08699

THE RIGHT TO A DECENT ENVIRONMENT: E—MC2: ENVIRONMENT EQUALS MAN TIMES COURTS REDOUBLING THEIR EF-

For primary bibliographic entry see Field 06E. W71-08700

THE WILD AND SCENIC RIVERS ACT OF 1968.

For primary bibliographic entry see Field 06E. W71-08701

AGRICULTURE: THE UNSEEN FOE IN THE WAR ON POLLUTION,

For primary bibliographic entry see Field 06E.

ENVIRONMENTAL CONTROL: HIGHER STATE STANDARDS AND THE QUESTION OF PREEMPTION,

For primary bibliographic entry see Field 06E. W71-08704

WATER POLLUTION CONTROL IN VERMONT: A SYSTEM OF EFFLUENT CHARGES, For primary bibliographic entry see Field 06E. W71-08705

SAVING BYRON'S SEA: FEDERAL AND STATE REGULATION OF OIL POLLUTION FROM OCEAN PETROLEUM PRODUCTION, For primary bibliographic entry see Field 06E.

OIL POLLUTION REGULATIONS. Coast Guard, Washington, D.C. For primary bibliographic entry see Field 06E. W71-08709

W71-08706

POLLUTION OF THE GREAT LAKES AND SOLID WASTE DISPOSAL AT SEA. For primary bibliographic entry see Field 06E.

LIABILITY FOR OIL POLLUTION CLEANUP--NON-SELF-PROPELLED BARGES EXEMPTED UNDER CERTAIN CIRCUMSTANCES.

For primary bibliographic entry see Field 06E. W71-08712

CHIPLEY V BEELER (LIABILITY FOR ALTER-ING FLOW OF SURFACE WATER). For primary bibliographic entry see Field 06E. W71-08717

STEPPED-UP WAR ON POLLUTION. For primary bibliographic entry see Field 06E. W71-08720

MORTALITY OF COLIFORM BACTERIA IN SEA WATER SAMPLES IN THE DARK. Water Pollution Research Lab., Sevenage. (En-

gland). E. B. Pike, A. L. H. Gameson, and D. J. Gould Revue Internationale d'Oceanographie Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Institut National de la Sante et de la Recherche Medicale, Fondation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 97-107. 8 ref.

Descriptors: \*Sewage, \*Bacteria, \*Coliforms, \*E. Coli, \*Mortality, Sea water, Temperature, Salinity, Water pollution control.

The mortality of sewage coliform bacteria and the factors influencing the rate of mortality along with Escherichia coli were studied in over 400 laboratory experiments. Coliform bacteria mortality in sea-

water, estuaries and rivers with domestic sewage present followed a first order kinetic pattern with the rate increasing with increase in temperature and salinity. The mortality rate of indigenous coliform bacteria in seawater was apparently not related to season or to amount of daylight. (Ensign-PAI) W71-08734

BIOLOGICAL FACTORS OF SELF-PURIFICA-TION OF SEA WATER: CLEAR AND OBSCURE POINTS OF A DEBATABLE QUESTION, (FAC-TEURS BIOLOGIQUES D'AUTOEPURATION DES EAUX DE MER: POINTS CLAIRS ET POINTS OBSCURS D'UNE QUESTION DISCU-

Naples Univ. (Italy), Istituto di Igiena. A. Paoletti.

Revue Internationale d'Oceanographic Medicale, Centre d'Etudes et de Recherches de Biologie et d'Oceanographic Medicale, Institut National de la Sante et de la Recherche Medicale, Foundation de la Ville de Nice, Nice, Vols 18 and 19, 1970, p 33-68, 312 ref.

Descriptors: \*Self-purification, \*Bacteria, \*Antibiotics, Sea water, Water purification, Water pollution control.

Identifiers: \*Bdellovibrio bacteriovorus, Filter

feeders, Lytic factors.

Self-purifying biological factors in sea-water, rivers, lakes, sewage treatment plants and soil are reviewed. These factors include bactericidic and antibiotic activity, bacteriophages, and Bdellovibrio bacteriovorus. Strong purifying activity was shown by filter-feeders. The presence of bacteriolytic moulds and bacteria indicated lytic factors to be of importance in self purification processes. (Ensign-PAI) W71-08738

THE FEASIBILITY OF OIL COLLECTION DEVICES,

Charles River Association, Wayland, Mass.
D. P. Hoult, R. H. Cross, Ill, and J. H. Milgran.
Available from the National Technical Information Available from the National Technical Information Service as AD-716 325, \$3.00 in paper copy, \$0.95 in microfiche. Final Report, US Coast Guard Contract Number Dot-CG-02, 346-A, June 24, 1970. 36 p, 8 fig, 2 tab, 4 ref. US Coast Guard Project No 704103/004.

Descriptors: Oil, \*Skimming, \*Diversion, \*Flow control, Numerical analysis, Water pollution control, \*Oil wastes, Oily water.

Identifiers: Surface skimmers, Laboratory models, Oil slicks.

Theoretical and experimental investigations of the flow of a thin oil film into a large, converging-channel surface skimmer were conducted. Three different flow regimes are described. Potentiality of large-scale skimmer devices, based on small-scale laboratory models and numerical analysis are considered. Configurations for the various regions of a skimmer and a design exercise based on an oil recovery rate of 200 tons per hour were developed. (Ensign-PAI) W71-08747

INVESTIGATION OF THE USE OF A BORTEX FLOW TO SEPARATE OIL FROM AN OIL-WATER MIXTURE,

United Aircraft Corp., East Hartford, Conn. Research Labs.

Arthur E. Mensing, Richard C. Stoeffler, William R. Davison, and Thomas E. Hoover.

Available from the National Technical Information Service as AD-716 309, \$3.00 in paper copy, \$0.95 in microfiche. Final Report, US Coast Guard Contract DOT-CG-00546-Å, Nov 1970. 90 p, 40 fig, 7 ref. US Coast Guard Report No 714103/Å/001.

Descriptors: \*Oil wastes, \*Oil-water interfaces, \*Separation techniques, \*Flow rates, \*Vortices,

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\*Cleaning, Model studies, Design, Equipment, Application methods, Water pollution control, Oily

A vortex separator as a component of an oil spill clean-up system was evaluated. This apparatus continuously separates the oil from an oil-water mixture with individual outlets for the oil and water. An experimental investigation of a laboratory-scale model vortex separator, to determine its adequacy for various geometric and flow conditions, and an evaluation of a full-scale vortex separator including the pumps and prime movers was conducted Criteria are given for design of full-scale vortex separator based on average residence time. Sizes, weights, and costs of separators, pumps and motors for volume flow rates between 1000 and 100,000 gpm were determined. (Ensign-PAI) W71-08749

# BIODEGRADATION OF OIL SLICKS IN THE MARINE ENVIRONMENT, Rutgers - The State Univ., New Brunswick, N.J.

Richard Bartha.

Available from the National Technical Information Service as AD-715 801, \$3.00 in paper copy, \$0.95 in microfiche. Office of Naval Research Technical Report No 1, Dec 1970. 10 p, 6 ref. NOOO 14-67-A-0115-0005 Task No NR 137-843.

Descriptors: \*Oil wastes, \*Biodegradation, \*Microorganisms, \*Chromatography, \*Separation techniques, Water pollution control.
Identifiers: Containment, Recovery, Hydrocar-

bons, Crude oil.

Biodegraded crude oil and individual hydrocarbons were tested and standardized by liquid-liquid extraction and gas chromatographic techniques. Several methods and devices were tested for containment and recovery of oil slicks in field studies. Floating frames, air-curtain devices and vertical glass tubes partially submerged by a styrofoam float are described and evaluated. Forty strains of oildegrading marine microorganisms were isolated in pure culture on sea salts media with individual hydrocarbons or crude oils as the added carbon source. The substrate range of these organisms was assessed on two types of crude oil and on eleven aliphatic, alicyclic and aromatic hydrocarbons. (Ensign-PAI)
W71-08750

# MARINE OIL POLLUTION AND THE WATER QUALITY IMPROVEMENT ACT OF 1970, New York Univ., N.Y. School of Law.

For primary bibliographic entry see Field 06E.

# CONTIGUOUS ZONES FOR POLLUTION CON-TROL: AN APPRAISAL UNDER INTERNA-TIONAL LAW,

Miami Univ., Fla

For primary bibliographic entry see Field 06E. W71-08754

# ESTUARIES -- AMERICA'S MOST VULNERA-BLE FRONTIERS, National Wildlife Federation, Washington, D.C.

Will Johns.

Available from National Wildlife Federation, Washington, DC, 20036, Price \$0.10. Rev ed 1969.

Descriptors: \*Esturaries, \*Conservation, \*Water pollution control, \*Water management, Estuarine environment, Adoption of practices, National resources, Water pollution abatement, Water pol-

Identifiers: Massachusetts Squaw's Hole Case, River basin studies, Florida conservation programs, Wetlands exploitation.

An estuary is a border between land and sea. Estuarine waters are the life-line of the sea, comprising a great natural resource. They have the one common characteristic, change. While little is ever lost in dynamic, natural change, great concern should be shown for the permanent change which man is causing in estuaries. A history is given of a century of wetlands exploitation, with new threats from pesticide and oil pollution. The first great in combating estuary deterioration is research, so that the value of estuaries can be realized. The Massachusetts 'Squaw's Hole Case,' 426 river basin studies, and Florida conservation programs are presented as examples of efforts to protect and save marshes and estuaries. Above all else, remaining estuarine areas must be left in their natural condition. (McEntyre-PAI) W71-08755

#### CONVENTION ON OIL **POLLUTION** AMENDED,

Shell International Marine Ltd., London (England). M. P. Holdsworth.

Marine Pollution Bulletin, Vol 1 (NS), No 11, p 168-69, Nov 1970.

Descriptors: \*Oil wastes, \*Water pollution control, \*Oil industry, \*Legislation, Ships, Regulation, Control systems, Monitoring.
Identifiers: \*IMCO, \*Amendments, International

Convention on Oil Pollution.

Amendments proposed to the Convention at the IMCO Assembly in October, 1969, are analyzed with respect to oil pollution control. Present provisions have not been effective for the following reasons: the limitation of effluent oil content by volume ratio is not necessarily relevant; enforcement has been impossible; and the 100 miles nodischarge zone is little protection against the waxy tank washing residues. The new amendments provide total prohibition of tank washing residue dumping, permits a tanker more than 50 miles offshore to discharge oil effluent if the oil instantaneous rate doesn't exceed 60 1. per mile of ship travel, and enables enforcement whereby a tanker which has cleaned on passage must arrive with full complement of residues. Additional new rules are discussed, including reasons for the deletion of existing Article III (c) which prohibited oil discharge from new tankers in excess of 20,000 gross tons. (McEntyre-PAI) W71-08756

### CRITICAL VIEW OF 1969 AMENDMENTS,

Nordic Union on Oil Pollution, Stockholm (Sweden). G. Boos.

Marine Pollution Bulletin, Vol 1 (NS), No 11, p 169-170, Nov 1970.

Descriptors: \*Oil wastes, \*Legislation, \*Water pollution control, \*Oil industry, Ships, Control systems, Monitoring, Regulation.
Identifiers: \*IMCO, \*Amendments,

\*Critical review, International Convention on Oil Pollution.

1961 Amendments adopted by the sixth IMCO Assembly restrict oil discharge from ships considerable more than previously. The impact for oil tankers is that the load-on-top system will be compulsory whereby oil discharge into the sea from tank washings and the ballast water is avoided. A small discharge will still be allowed on the way to the loading port not nearer than 50 miles to land and only with certain precautions. Drawbacks of the various amendments are examined, showing that there will still be permitted a large amount of oil discharge and of such nature that it will persist until it reaches shore. A serious retrogression is the abandonment of the present requirement of total oil discharge prohibition for new ships of 20,000 tons gross or more. The ultimate goal of total oil discharge prohibition has once again been put off for a future time. (McEntyre-PAI) W71-08757

OIL POLLUTION DEFENSE SYSTEM. Harding Pollution Control Corp., West Hempstead,

Undated, 15 p. 5 fig.

Descriptors: \*Gulf of Mexico, \*Oil wastes, \*Water pollution treatment, \*Water pollution control, Equipment, Oil industry, Pollution abatement.
Identifiers: \*Pollution defense stations, \*Oil containment, \*Oil recovery, Oilevator.

The Harding Oil Pollution Defense System, a system for the containment and recovery of oil spills, is presented. Containment procedures are explained and illustrated whereby encirclement of explained and illustrated whereby encirclement of the oil spillage is accomplished by means of a verti-cal barrier called the Bennett Oil Containment Boom. The recovery of the spilled oil is accom-plished by the Oilevator, which 'laps up' the oil by a conveyor belt, leaving behind the sea water. Addi-tional information includes Oilevator specifications and illustration, and independent test reports from Shell Pipeline Company and Imperial Oil Enter-prises Limited. The Gulf Coast Plan would establish five Pollution Defense Stations along the Gulf Coast. The stations would be equipped with the Bennett offshore boom and up to 5 Oilevators, and staffed with standby crews. The economics of such a program is explained and a price schedule included. (McEntyre-PAI) W71-08758

### MARINE POLLUTION AND FISHERIES,

Peter Hjul, and David Glen.

A special report on the FAO Technical Conference in Rome, December 1970. Fishing News International, Vol. 10, No. 2, p 12-22, February, 1971.

Descriptors: \*United Nations, \*Water pollution control, \*Water pollution sources, \*Water pollution effects, Water law, Monitoring, Control

systems.
Identifiers: \*FAO conference, Marine pollution, International cooperation.

A summary report is given of the FAO Technical Conference on Marine Pollution and its Effects on Living Resources and Fishing, held December 9-18, 1970, in Rome, with 415 delegates attending from over 40 countries and a dozen international organizations. The overall consensus was that marine pollution, while becoming increasingly seri-ous, can still be controlled and abated through scientific endeavor and a global system of monitoring. Topics covered were offshore dumping, mer-cury poisoning, oil pollution, shellfish vulnerability, industrial pollutants, metal compounds, pesticide pollution, pollution of coral reefs, effects on ecosystems, role of population in pollution, international controls, fishing bans, and an effective global pollution monitoring system. (McEntyre-PAI) W71-08765

### AFTERMATH OF CALIFORNIA SPILL LIN-GERS.

Bill Rintoul.

Offshore, Vol. 31, No. 4, p 52-53, April, 1971.

Descriptors: \*Oil wastes, \*Ships, \*Legislation, \*California, Shore birds, Water pollution control, Legal aspects.

Identifiers: \*Oil spill, \*San Francisco Bay, \*Oil tanker collision.

The collision of two Standard Oil Company tankers beneath San Francisco's Golden Gate Bridge in January 1971, and the resultant 20,000 bbls oil spillage into San Francisco Bay, are described. Cleanup efforts of Standard Oil were commended, with about two thirds of the spillage recovered. Property owners and boat owners brought three class-action lawsuits amounting to billions of dollars in damage against the company. The proposed Congressional port and harbor safety bill, and the bridge-to-bridge communications

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discussed. The first bill would strengthen Coast Guard powers to regulate harbor area traffic, including mandatory manning of ship-shore radio cir-cuits. The second bill would require all ships in and around harbors to maintain voice communications by bridge-to-bridge radiotelephone. An examina-tion of how the collision occurred was aided by a sequence of radar pips taken by a Coast Guard ausequence or radar pips taken by a Coast Guard automatic camera. Special efforts were made at the bird-cleaning and recovery centers of the San Francisco Zoo and the University of California Services Center to save oil-soaked sea birds, but survival rates were low. (McEntyre-PAI) W71-08767

WATER POLLUTION FROM PHOSPHATE, For primary bibliographic entry see Field 05C.

HUGHES V VILLAGE OF NASHWAUK (LIA-BILITY OF CITY FOR NUISANCE CAUSED BY OVERFLOW OF SEWER).

For primary bibliographic entry see Field 06E. W71-08769

PHYSICAL DATA POTOMAC RIVER TIDAL SYSTEM INCLUDING MATHEMATICAL MODEL SEGMENTATION, Federal Water Quality Administration, Annapolis,

Md. Chesapeake Support Lab. For primary bibliographic entry see Field 02L. W71-08774

BIOLOGICAL AND OCEANOGRAPHICAL SURVEY OF THE SANTA BARBARA CHAN-NEL OIL SPILL 1969-1970, VOLUME I: BIOLOGY AND BACTERIOLOGY; VOL II: PHYSICAL, CHEMICAL AND GEOLOGICAL

University of Southern California, Los Angeles. Allan Hancock Foundation.

For primary bibliographic entry see Field 05C. W71-08776

#### **ECONOMICS OF WATER QUALITY CONTROL** MEASURES,

Idaho Univ., Moscow. Water Resources Research

E. L. Michalson.

Speech at Annual Meeting of Soil Conservation Society of America, Boise, Idaho, Nov 21-22, 1969. 12 p, 1 fig.

Descriptors: \*Water quality control, \*Economics, \*Waste water treatment, Pollution abatement, Idaho, \*Planning, Water resources development, Evaluation, Water pollution control. Identifiers: Environmental quality.

A basin wide water quality control program in Idaho is investigated. Water quality problems in Idaho include agricultural (chemical and animal), municipal (water supply and waste disposal), and industrial (discharge and thermal pollution). Water has two particular characteristics affecting quality control: it has an ability to renew itself, and it has a natural ability to oxidize and stabilize organic wastes on a continuous basis. When the waste load of a stream is too great for the stream to assimilate, there are four alternative methods available to control water pollution: (a) low flow augmentation, (b) prevention, (c) treatment, (d) recycling of effluents. In an economic sense there are two characteristics of water quality that create problems: (1) variability of the water supplies, (2) differentiation of demand for water of various qualities according to uses. Another problem is that benefits are difficult to identify and almost impossible to quantify. For these reasons the major economic interests revolve around the costs of control measures. Costs to society and the industrial polluter need to be determined. Some form of governmental coordination on water quality at the federal level is necessary to insure standards. When the problem of water quality control is adequately defined, then engineers, economists and other research workers can formulate optimal plans. (ray-Chicago)

REVIVING THE GREAT LAKES,

Chicago Univ., Ill. Center for Urban Studies.
John R. Sheaffer.

Saturday Review, p 62-65, Nov 7, 1970. 2 figures.

Descriptors: \*Waste water disposal, Area redevelopment, \*Water pollution control, \*Irrigation water, Crop production, Michigan, Irrigation. Identifiers: \*Muskegon County (Mich).

This article describes the plans for the initiaton of a large-scale water pollution control project on the eastern shore of Lake Michigan in Muskegan County. Using the approach of a 'closed ecological system,' the project will clean up the lake by diverting sewage away from the lake and into production as irrigation, water. Although the author available. ing sewage away from the lake and into production as irrigation water. Although the author explains that the original cost of the project is more than alternative short term treatment plant proposals, the economic potential of the project is enormous. Not only will the newly irrigated lands be able to proonly will the lewly in gated lands of a bot to provide profitable corn production, the employment and recreational possibilities will be expanded as well in the area. (Holmes-Rutgers) W71-08822

ORSANCO: PIONEER WITH A NEW MISSION. Peter J. Piecuch

Environmental Science and Technology, Vol 5, No 1, p 22-23, Jan 1971. 1 fig.

Descriptors: \*Water quality control, \*Regions, Political aspects, \*Water pollution control, Ohio. Identifiers: \*Ohio River, Ohio River Valley Water Sanitation Commission (ORSANCO).

This article describes the regional approach to water pollution control regulation carried out by the Ohio River Valley Water Sanitation Commission during its twenty-two year history. Although ORSANCO, as the commission is referred to, is not a treatment authority, it has been instrumental in monitoring the water quality of the Ohio River and in enforcing the Federal government's and its own water quality standards. The author underlines the importance of the regional in contrast to the federal approach to water pollution control enforcement. (Holmes - Rutgers) W71-08825

### WEEPING LOVEGRASS FOR VEGETATING STRIP-MINE SPOILS IN APPALACHIA,

Northeastern Forest Experiment Station, Berea, Ky. Willis G. Vogel.

In: Proc First Weeping Lovegrass Symposium, The Samuel Roberts Noble Foundation, Ardmore, Oklahoma, p 152-162, Apr 28-29, 1970.

Descriptors: \*Strip mines, \*Vegetation establishment, \*Cover crops, \*Appalachian mountain region, Spoil banks, Grasses, Legumes, Forage mixtures, Hydrogen-ion concentration, Revegetation, Nutrient requirements, Black locust trees, Reclamation, Kentucky.

Identifiers: \*Weeping lovegrass, \*Strip-mine reclamation, Cover crops.

Weeping lovegrass is useful for vegetating stripmine spoils in Appalachia because it produces quick cover on a wide range of spoil conditions. It is more tolerant of extremely acid spoils (pH 4.0-4.5) and of dry sites and summer growing conditions than most of the commonly used cool-season grasses and legumes. Although relatively short-lived, it works well in mixtures with slowerdeveloping, long-lived grasses and legumes. It provides the desired quick cover during the first growing season but does not crowd out the companion species, which usually obtain dominance by the third growing season. When sown with directseeded black locust, lovegrass is less competitive with the locust seedlings than are the oft-used coolseason grasses. Nitrogen and phosphorus fertilizers are needed for establishing quick cover of lovegrass on many Appalachian coal-mine spoils. (Vogel-W71-08857

SUMMARY OF INTERIM GUIDELINES FOR DISPOSAL OF SURPLUS OR WASTE PESTICIDES AND PESTICIDE CONTAINERS. Working Group on Pesticides, Rockville, Md.

Available from the National Technical Information Service as AD-720 391, \$3.00 in paper copy, \$0.95 in microfiche. Working group report WGP-DS-1,

Descriptors: \*Pesticides, \*Waste disposal, \*Industrial wastes, \*Water pollution, Sanitary engineering, Incineration.

Identifiers: Incinerators, Fire safety, Public health, \*Pesticide disposal.

An interim guideline for surplus or waste pesticides and pesticide container disposal has been drawn from the combined important points of three Working Group reports. WGP-DR-1, Ground Disposal of Pesticides: The Problem and Criteria for Guidelines; WGP-DR-2, Proceedings of National Working Conference on Pesticide Disposal; and WGP-DR-3, Information Available on Handling Surplus Pesticides Empty Containers and and WGF-DR-3, Information Available on Handling Surplus Pesticides Empty Containers and Emergency Situations. Presented in concise form for ready reference, the subjects of ocean disposal (not recommended), ground disposal and incineration (air disposal) are reviewed. Orientation is to different pesticide users: householders, farm operators, commercial operators, governmental authorities, industrial users formulators, manufacturers. Ground disposal, its attendant precautions and controls, are discussed as well as methods and disposal site requirements. Incineration technology to date is outlined as the most applicable method of disposal for large amounts of toxic wastes and unusable pesticides. Sections on collection systems as practiced and recommended in various areas including transportation of surplus pesticides and containers, storage considerations with fire and safety precautions, disposal site monitoring and suggested research bring the whole problem into focus. The summary of guidelines provides preliminary guidance with expectation of revision when more definitive solutions are available. Not a set of specific recommendations on disposal. W71-08869

# SUMMARY OF FINDINGS ON SOLID WASTE DISPOSAL SITES IN NORTHEASTERN IL-

Illinois State Geological Survey, Urbana. G. M. Hughes, R. A. Landon, and R. N. Farvolden. Illinois Geological Survey Environmental Geology Notes, No 45, Apr 1971. 25 p, 15 fig, 1 tab, 5 ref. EPA Grant No G06-EC-00006.

Descriptors: \*Landfills, \*Illinois, \*Water pollution control, Path of pollutants, Garbage dumps, Sanitary engineering, Waste disposal, Environmental sanitation

Identifiers: \*Sanitary landfills.

If groundwater pollution alone is considered, approximately 80% of northeastern Illinois should be suitable for sanitary landfilling with little or no site modification, because the surficial materials are fine textured, have low permeability, and would restrict the movement of leachate. Another 10% should be suitable because of favorable location in the hydrogeologic flow system. Sites in the remaining 10% may require considerable modification. Unfortunately, a large percentage of the sites proposed as sanitary landfills fall into this last category, a group that includes mined-out quarries and gravel pits. Such sites are easily filled, and, when filled, increase substantially in value. However, they are not safe landfill sites unless modifica-

### Techniques of Planning—Group 6A

tions are made. Fine-textured sediments, such as glacial tills, are much more effective than more permeable sands and silts in removing dissolved solids from leachate. Dissolved solids in leachate that travels through 5 feet of sandy clay till are reduced approximately the same amount as solids in leachate that travels through 600 feet of outwash sand and silt. (Knapp-USGS)
W71-08901

UTILITY OF RADIOISOTOPE METHODOLO-GY IN ESTUARY POLLUTION CONTROL STU-DIES--PART 1: EVALUATION OF THE USE OF RADIOISOTOPES AND FLUORESCENT DYES FOR DETERMINING LONGITUDINAL DISPER-SION COEFFICIENT IN ESTUARIES, Quirk, Lawler and Matusky Engineers, New York. Quirk, Lawler and Matusky Engineers, New York. Karin A. Abood, John P. Lawler, and Michael D.

Report available form Nat Tech Inf. Service, Springfield, Va.--Price \$3.00 in paper copy. \$0.95 in microfiche. U S Atomic Energy Commission New York Operations Office Report NYO-3961-1 (Division of Technical Information TID-4500), August 1969. 197 p, 44 fig, 3 chart, 27 tab, 73 ref. 3 append. USAEC Contract AT- (30-1)-3961.

Descriptors: \*Streamflow, \*Tracking techniques, \*Tracers, \*Path of pollutants, Fresh water, Estuarties, Dye releases, Radioisotopes, Reviews,

Identifiers: \*Streamflow characteristics.

Radiotracers and fluorescent dyes used in estuarine studies are compared. The comparison is based on the behavior and characteristics of the tracers, the required survey equipment, manpower needs, and associated problems encountered in the field investigation. A detailed procedure is presented for analysis of an instanteously released tracer. This handbook solution is suitable for selection of the type of tracer and the required quantity necessary for measurement of dispersion and flow characteristics in a given river or estuary. Also included are: (1) an economic comparison of prototype and hydraulic model tracer surveys; (2) the merits and disadvantages of using dyes and radiotracers; (3) delineation of tracer programs for estuarine pollution control studies; and (4) mathematical models describing the time and space distribution of tracers in waterways. (Woodard-USGS) W71-08928

REAERATION IN OPEN-CHANNEL FLOW, Geological Survey, Fort Collins, Colo. For primary bibliographic entry see Field 08B. W71-08936

### 06. WATER RESOURCES **PLANNING**

### 6A. Techniques of Planning

DIGITAL SIMULATION OF THE OGALLALA AQUIFER SHERMAN COUNTY. IN NORTHWESTERN KANSAS,

Kansas State Geological Survey, Lawrence; and Geological Survey, Lawrence, Kans. For primary bibliographic entry see Field 02F. W71-08355

NUMERICAL MODEL OF THE OGALLALA AS A MANAGEMENT TOOL, Texas Technological Coll. Lubbock. Dept. of Civil

Engineering.
B. J. Claborn, T. Al Austin, and D. M. Wells. In: The Ogallala Aquifer--A Symposium, Texas Tech University, Lubbock, International Center for Arid and Semi-Arid Land Studies Special Report No 39, p 89-110, 1970. 22 p, 10 fig, 3 tab. OWRR Project C-1537 (No 1993) (2). Descriptors: \*Simulation analysis, \*Computer programs, \*Water balance, \*Aquifers, \*Water resources development, Kansas, Recharge, Withdrawal, Discharge (Water), Groundwater movement, Transmissivity, Irrigation water, Municipal water, Water sources, Groundwater, Water levels, Water utilization, Hydrologic budget, Hydrogeology.
Identifiers: \*Ogallala aquifer (Texas).

A digital simulation model constructed by the California Department of Water Resources for application in the Riverside-Chino Basin area of Los Angeles County was adapted to a portion of the Southern High Plains of Texas. The portion of the High Plains Underground Water Conservation District Number 1 lying within Potter, Randall, Deaf Smith, Parmer, Castro, Bailey, and Lamb Counties was selected for use in this study. Total area is 3,182.4 square miles. The study area was later reduced to a portion of the original study area lying reduced to a portion of the original study area lying in Parmer, Lamb, Castro, and Bailey Counties, an area of 2,288.6 square miles. The model should have substantial value to management as a decision making tool, but application is badly handicapped at the present by lack of high quality input data. (See also W71-08349) (Knapp-USGS)

### DYNAMIC MODEL OF THE OGLLALA AQUIFER,

High Plains Underground Water Conservation District No. 1, Lubbock, Tex.

F. A. Rayner.

In: The Ogallala Aquifer--A Symposium, Texas Tech University, Lubbock, International Center for Arid and Semi-Arid Land Studies Special Report No 39, p 111-117, 1970. 7 p, 3 fig, 1 ref. OWRR Project C-1537 (No 1993) (3).

Descriptors: \*Simulation analysis, \*Computer programs, \*Water balance, \*Aquifers, \*Water resources development, \*Dynamic programming, Kansas, Recharge, Withdrawal, Discharge (Water), Groundwater movement, Transmissivity, Irrigation water, Municipal water, Water sources, Groundwater, Water levels, Water utilization, Hydrologic budget, Hydrogeology. Identifiers: \*Ogallala aquifer (Texas).

The magnitude of the economic dependence upon the Ogallala aquifer has established a trend to its depletion, and as the water table draws closer to the base of the aquifer, the configuration of the aquifer is undergoing change. Therefore, to economically model this aquifer to a nearly depleted condition requires a dynamic model that can effect its own internal adjustment to compensate for the changes in aquifer configuration. (See also W71-08349) (Knapp-USGS) W71-08357

# NUMERICAL SIMULATION OF WATERSHED HYDROLOGY, Texas Univ., Austin. Dept. of Civil Engineering.

For primary bibliographic entry see Field 02A. W71-08392

### WATER RESOURCE SYSTEM OPTIMIZATION BY GEOMETRIC PROGRAMMING,

Texas A and M Univ., College Station. W. L. Meier, Jr., C. S. Shih, and Duane J. Wray. Available from the National Technical Information Service as PB-199 645, \$3.00 in paper copy, \$0.95 in microfiche. Water Resources Institute, Technical Report No. 34, Feb 1971, 117 p, 6 fig, 1 tab, 60 ref, 2 append. OWRR Project A-011-TEX (4).

Descriptors: \*Optimization, \*Optimum development plans, Planning, Design, \*Dynamic programming, Linear programming, Water utilization, Costs, \*Cost analysis, Filtration, Water purification, Waste water treatment, Model studies, \*Comnuter models.

Identifiers: \*Geometric programming, Cos models, \*Filtration systems, Computer algorithms.

The aim of this research was to study the applicability and usefullness of geometric programming in water resource planning and design activities. To study the use of geometric programming in practical problem solving, a computer algorithm was developed. A variety of water resources problems were solved using the algorithm. There is a significant need for techniques which will permit design and operation of either proposed or existing water filtration systems. Because the cost models and constraints for water filtration design problems are generalized polynomials, geometric programming would be a good optimization technique to use. Because water filtration problems have not been the subject of optimization analyses in the past to any significant degree, some time was spent in developing cost models and formulating the problem. This effort and the optimization analysis combining linear and geometric programming is described extensively in the report. The report includes a tutorial explanation of geometric programming a description of the computer selectivity. cludes a tutorial explanation of geometric pro-gramming, a description of the computer algorithm used, the description of the water filtration cost model, and an explanation of the use of geometric programming in an application. W71-08393

# ECONOMIC MODELING IN NATURAL RESOURCE PLANNING, Rocky Mountain Forest and Range Experiment

Station, Tucson, Ariz. For primary bibliographic entry see Field 06B. W71-08445

### EVALUATION OF THE WORTH OF ADDI-TIONAL DATA,

Arizona Univ., Tucson. Dept. of Systems Engineer-

Donald R. Davis, and William M. Dvoranchik. 1970. 11 p, 4 ref. OWRR Project B-007-ARIZ (7).

Descriptors: \*Evaluation, \*Value, \*Decision making, \*Systems analysis, \*Investment, Hydrologic data, Costs, Limiting factors, Analysis, Bridge design, Optimum development plans, Computer programs, Computer models. Identifiers: \*Decision theory, \*Uncertainty, \*Utility function, \*Goal selection, \*Bayes risk, Expected variable cost, Opportunity loss, Search routine, Integration, Objective function, Error levels, Rillito Creek (Tucson-Ariz)

Creek (Tucson-Ariz).

Decision processes involve uncertainty which is reduced with information. Because perfect hydrologic knowledge requires highly excessive investment, this paper delineates a method which evaluates uncertainty in hydrologic decision making. The report compares uncertainity to cost, and provides a basis for deciding when additional data is economically excessive. Decision definition, goal selection (utility function), decision making and uncertainity analysis are outlined. An imaginatively treated example of deciding on the depth of bridge piles for Rillito Creed, Tucson, Arizona, is piles for Killito Creed, Tucson, Arizona, is developed in terms of Bayes risk (expected variable cost) and opportunity loss. Programming methodology includes search routine, one- and two-dimensional integration, and objective function. Error levels and limits of integration are evaluated. The computer program took 235 seconds. It indicated that a Bayes risk of \$7,479, expected opportunity loss of \$2,930, expected opportunity loss of \$2756 for an additional year's data beyond 1950. of \$2756 for an additional year's data beyond 1950 to 1960 record, produced a minimized depth of 16.1 feet. There was a \$90 Bayes risk variation from 15 to 17 feet. The object was to minimize the Bayes risk for a given pile depth. (Popkin-Arizona)

# DISCRETE DIFFERENTIAL DYNAMIC PROGRAMMING APPROACH TO WATER RESOURCES SYSTEMS OPTIMIZATION,

Illinois Univ., Urbana. Manoutchehr Heidari, Ven Te Chow, Petar V. Kokotovic, and Dale D. Meredith.

Water Resources Research, Vol 7, No 2, p 273-282, Apr 1971. 10 p, 8 fig, 2 tab, 15 ref. OWRR Project B-030-ILL (5).

# Group 6A—Techniques of Planning

Descriptors: \*Optimization, \*Dynamic programming, \*Water resources development, Linear programming, Time, Operations, Digital compu-

Identifiers: \*Iterative technique, Recursive equa-tion, Trajectories, Invertible systems, Memory requirements.

An iterative method that could ease the difficulties of memory requirements and computer time requirements for the optimization of operating polrequirements for the optimization of operating policies of multiple unit and multiple purpose water resources systems by traditional dynamic programming with the use of high speed digital computers was presented. The discrete differential dynamic programming (DDDP) approach was an iterative technique in which Bellman's recursive equation of dynamic programming was used to search for an improved trajectory among the dis-crete states in the neighborhood of a trial trajectory. The method was used for an invertible, multiple dimensional system and the procedure accuracy dimensional system and the procedure accuracy and speed was much greater than the accuracy and speed of an interpolation procedure. A simplified system, which was formulated and solved by Laison by linear programming and succesive approximation dynamic programming, was solved by means of the proposed approach. The operating policy of the four-dimensional reservoir network was optimized. over 12 operating periods and was used as an illustrative example. By limiting optimization to a few lattice points around a trial trajectory, the memory requirement was curbed substantially and computer time was reduced since fewer tests had to be made per state of each stage. Has 15 references. (Kriss-Cornell) W71-08500

SPACE-TIME VALIDATION OF A THUN-

DERSTORM RAINFALL MODEL,
Arizona Univ., Tucson. Dept. of Watershed Management.

For primary bibliographic entry see Field 02B. W71-08530

EXPERIMENT IN DETERMINISTIC WATERSHED MODELING,

Montana State Univ., Bozeman. Dept. of Earth Sciences.

For primary bibliographic entry see Field 02A. W71-08531

NATIONAL SYMPOSIUM ON DATA AND INSTRUMENTATION FOR WATER QUALITY MANAGEMENT.

For primary bibliographic entry see Field 05A. W71-08550

COORDINATION - THE KEY TO EFFECTIVE WATER DATA MANAGEMENT, Geological Survey, Washington, D.C. Office of

Water Data Coordination. For primary bibliographic entry see Field 05A. W71-08552

A SYSTEMS APPROACH TO WATER OUALI-

TY DATA MANAGEMENT,
Price Waterhouse and Co., Philadelphia, Pa. Management Advisory Services. For primary bibliographic entry see Field 05A. W71-08554

FORECASTING OF WATER QUALITY DATA IN THE DELAWARE RIVER ESTUARY,

Delaware River Basin Commission, Trenton, N.J. For primary bibliographic entry see Field 05A. W71-08557

A MATHEMATICAL MODEL FOR DETERMIN-ING AREAL DISTRIBUTION OF NATURAL RECHARGE IN THE NORTHERN HIGH PLAINS OF COLORADO,

Texas A and M Univ., College Station. Dept. of Agricultural Engineering.

For primary bibliographic entry see Field 02F. W71-08575

PROBABILITY THEORY AS AN AID TO

RESEARCH PLANNING, Wisconsin Univ., Madison. Dept. of Civil Engineer-

Journal American Water Works Association, Vol 61, No 2, p 652-658, 1970. 6 fig, 4 tab, 9 ref.

Descriptors: \*Decision making, \*Economic prediction, \*Pilot plants, \*Cost-benefit ratio, Probability, Analytical techniques, Planning, Design data, Model studies, Research and development, Network design. Identifiers: \*Probability theory, Utility theory.

The theory of probability has been used to evaluate the problem of iron removal by oxidation and rapid sand filtration. The efficiency and cost of different treatments are estimated on the basis of simple probability equations for independent, mutually exclusive, and not mutually exclusive events or components. A network diagram and tables provide illustrations of the probability analysis for all possible outcomes. Because the probabilities are asrequires a partnership between the theory and personal judgment. (Wilde-Wisconsin)
W71-08682

CONTINUOUS SYSTEM MODELS OF OXYGEN DEPLETION IN A EUTROPHIC RESERVOIR, Oklahoma State Univ., Stillwater. Dept. of Chemis-

Louis P. Varga, and C. Paul Falls.

Available from the National Technical Information Service as COO-2070-1, \$3.00 in paper copy, \$0.95 in microfiche. Oklahoma State University, Stillwater, Reservoir Research Center (Undated). 33 p, 16 fig, 1 tab, 32 ref.

Descriptors: \*Mathematical models, \*Reservoirs, \*Eutrophication, Computer models, Water quality, Dynamic programming, Reservoir operation, Impoundments, Oxidation-reduction potential, Dissolved oxygen, Water pollution effects, Anaerobic conditions, Dissolved solids, Density currents, Aeration, Biochemical oxygen demand, Chemical oxygen demand, Flow rates

Identifiers: \*Keystone Reservoir (Okla), \*Oxygen depletion.

Keystone Reservoir on the Arkansas River (Oklahoma) is fed by two chief tributaries, the Arkansas River of good quality water and the Cimarron River, containing natural brine and four times the dissolved solids of the Arkansas River, thus establishing a deep density current. Because the reservoir shoreline is rapidly becoming urban, natural and cultural eutrophication is anticipated. The long-term objective is to establish a chemicalphysical-mathematical model to improve understanding of ecoregulating parameters to serve as a base for comparative studies of other impoundments and give insight into problems of water quality management. Based on the premise that a lake is cutrophic when any portion becomes anaerobic, mathematical simulation models were designed choosing dissolved oxygen concentration as the dependent variable. Mathematical model configurations are described, including linear (along reservoir bottom), depth axis, 10-mesh triangular matrix, 6x18 triangular matrix, time-dependent linear, and branched 10-compartment model; the latter appears the most powerful tool in reservoir ecosystem modeling--not only can the input and output fluxes of any given constituent be monitored at each compartment in the reservoir network, but the effect of each flow rate and chemical reaction rate on the critical fluxes and concentrations can be readily followed and interpreted. (Auen-Wisconsin) W71-08684

RISK EVALUATION IN SEWAGE TREATMENT PLANT DESIGN

Cornell Univ., Ithaca, N.Y.

For primary bibliographic entry see Field 05D. W71-08819

ECONOMIC ANALYSIS OF IRRIGATION IN SUBHUMID CLIMATE,

Montana State Univ., Bozeman. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 03F.

W71-08824

THE ROLE OF THE DRILLING CONTRACTOR OVERSEAS AS SEEN BY THE OPERATOR, Amoco International Oil Co., Chicago, Ill.

J. T. Wilson. Paper, Thirtieth Annual Meeting American Association of Oilwell Drilling Contractors, Dallas, Texas, Sept 22-25, 1970. 6 p.

Descriptors: \*Oil industry, \*Foreign projects, \*Drilling, Foreign construction, Contracts. Identifiers: \*Overseas contracting, Drilling contractor responsibilities, Functions, Problems.

This paper presents the would-be drilling contractor with the opportunity of knowing what to expect if a overseas contract is accepted. Although interpreted through the experiences of an American Oil company active in overseas operations, the presentation offers many helpful hints for the water well contractor interested in overseas drilling contracts. An understanding and appreciation of: (1) the overseas political and social environment; (2) the unusual logistical problems and (3) the sometimes complex financial structure, are necessary prerequisites to a successful operation overseas by the contractor. (Campbell-NWWA) W71-08841

GENERAL HYDRAULIC SYSTEM MODEL, Illinois Univ., Urbana. Dept. of Hydraulic Engineering; and Madras Univ., India College of En-

gineering. For primary bibliographic entry see Field 04A.

W71-08909

### 6B. Evaluation Process

A STUDY OF THE EFFECTS OF INSTITUTIONS ON THE DISTRIBUTION AND USE OF WATER FOR IRRIGATION IN THE LOWER RIO GRANDE BASIN, Texas A and M Univ., College Station.

Roy M. Gray, and Warren L. Trock.

Available from the National Technical Information

Service as PB-199 647, \$3.00 in paper copy, \$0.95 in microfiche. Technical Report No 36, March, 1971, 92 p, 2 fig, 20 tab, 40 ref. OWRR Project B-025-TEX (8).

Descriptors: \*Institutions, Planning, \*Irrigation, \*Water rights, Irrigation districts, Cost, \*Water allocation, Irrigation efficiency.

Parametric linear programming was used to analyze the impact of negotiable water rights on cropping patterns and enterprise combinations. If the institution of water rights were changed so as to make annual allotments negotiable, market forces could be expected to move the resources into uses in which it has a higher value. Water price was varied from \$9.60 per acre foot to \$96.00 per acre foot. At a price of \$9.60, which is approximately the present cost of irrigation water delivered at the farm gate, producers could profitably use almost 2,000,000 acre feet of water per year. At this price, 83 percent of the irrigable lands and 77 percent of the water used in the Valley would be devoted to the production of cotton and grain sorghum. At a water price of \$18.65 per acre foot or higher, grain sorghum production in the Valley (Lower Rio Grande Basin) reverts dryland and water use for ir-

### **Evaluation Process—Group 6B**

rigation drops to 1,363,300 acre feet per year. At a price of \$32.45 or above, the land devoted to cotton would be switched to dryland grain sorghum production and water use would decline to 407,900 acre feet annually. The use of parametric programming with variable water pricing allowed the derivation of a value-in-use or 'conditional de-mand' curve for water. Rehabilitation of district facilities was analyzed using data from the parametric programming model for five levels of development. It was found that rehabilitation of district facilities is economically feasible, at present level of water use in the Valley. W71-08395

ECONOMIC MODELING NATURAL RESOURCE PLANNING,

Rocky Mountain Forest and Range Experiment Station, Tucson, Ariz. Paul F. O'Connell.

Proceedings, 14th Annual Arizona Watershed Symposium, Phoenix, Sept 23, 1970, p 31-38, 1971. Economic Evaluation of Watersheds in the

Descriptors: \*Model studies, \*Systems analysis, \*Planning, \*Economic impact, \*Natural resources, Watersheds (Basins), Arizona, Chaparral, Multiple-purpose projects, Resource allocation, Environmental effects, Cost-benefit analysis, Wildlife management, Economic efficiency, Intangible benefits, Linear programming.

Economics involves human goals, both market and non-market, and economists are not merely accountants, but social scientists. Multiple use resource management is a question of economic tradeoffs and therefore deserves discursive economic analysis. Cost-benefit analysis usually done for large reservoir and reclamation projects are deficient because market value methodology is lacking, secondary negative effects and marginal analyses are not considered, and detailed cost and benefit information are developed for only one alternative. Using these factors with optimum product mix considerations, the author attempted a cost-benefit analysis model for multiple use natural resource planning in the Salt-Verde Basin, Arizona. The objectives were: (1) An analysis of alternate watershed management programs in the area, considering all known products, alternative treatments and alternative input quantities in order to find an optimal combination, (2) Assessment of alternative program impacts on national, regional and local economic areas. Pert diagrams for data collection and processing are outlined and a linear program model was constructed, which shows how various combinations of treatments effect differing outputs. Data collection methods in the National Forest are described. Coefficients for inputs, outputs and treatments were developed and a sensitivity analysis was utilized to determine their effect on the outcome of the model. Data collection is the most costly part of the entire procedure. The model is capable of evaluating both non-market and market factors. Model applications to a chaparral area, with 4 alternatives, are described. (Cascy-Arizona) W71-08445

### THE CALIFORNIA WATER PLAN,

Loughborough Univ. of Technology (England). Leonard M. Cantor.

Journal of Geography, Vol 68, No 6, p 336-371, Sept 1969.

Descriptors: \*Inter-basin transfers, \*California, \*Water storage, \*Dams, \*Planning, Conveyance structures, Central Valley Project, Irrigation districts, Drainage systems, Arid lands, Pumping

The California Water Plan has been devised to transport water from its origin in the northern part of the state to the southern part where the highest concentration of population and the greatest need for irrigation and industrial development exist. Various components dams, aqueducts, pumping stations, and reservoirs - have already been completed, and others are under construction or in the planning stages. Criticism has developed focussing on inadequate drainage systems, increasing salinization, and skyrocketing costs. It is suggested that by the time the project is completed in 1980 desalination of seawater will be competitive in cost, and could have avoided the detrimental effects of the present plan (Caseuvironmental effects of the present plan. (Casey-Arizona) W71-08446

NEGLECTED RESOURCE, Moscow State Univ. (USSR). Dept. of Soil Science.

Presented at an international conference 'Arid Lands in a Changing World,' Tucson, Arizona, June 1969. In: Arid Lands in Transition, Dregne, H E (ed), Pub No 90, AAAS, p 473-479, 1970. 1 ref.

Descriptors: \*Arid lands, \*Water supply, \*United Nations, \*Irrigation practices, \*Productivity, Water resources development, Social aspects, Organizations, Investment, Natural resources, Scientific personnel.

Identifiers: \*Agrarian reform, \*Developing countries, \*Green revolution, \*Development obstacles.

If one compares the speed of change in different geographic areas of the world, the arid areas suffer by the comparison. The time has therefore come to reevaluate traditional approaches to the problem of aridity. The problem of water supplies has been somewhat alleviated by great advances in ground-water exploration and advances in desalination combined with contemplated interbasin transfers should eventually have great impact on arid areas. The green revolution has led to great crop production increases but the picture is mixed. Dryland farming productivity remains low, irrigation efficiency is low and salinity problems are increasing in irrigated areas. Many international organizations are helping, but the basic fact of 5-10 cents per capita investment in arid-zone science as compared with 2-7 dollars per capita in developed countries shows that international organizations can at best play only a catalytic role in development in underdeveloped countries. There are 4 major obstacles to future progress: (1) Low industrial potential, which is the crucial obstacle; (2) Agrarian reform, which would provide incentives to the population; (3) The great need for natural resource surveys; (4) The outmigration of native scientists to the developed countries. (Casey-Arizona) W71-08448

### UNRESOLVED ISSUES,

Chicago Univ., Ill. Dept. of Geography. Gilbert F. White.

Presented at an international conference, 'Arid Lands in a Changing World,' Tucson, Arizona, June 1969. In: Arid Lands in Transition, Dregne, H E (ed), Pub No 90, AAS, p 481-491, 1970.

Descriptors: \*Arid lands, \*Social aspects, \*Water resources, \*Education, \*Economic feasibility, Irrigation practices, Ecology, Natural resources. Identifiers: \*Population pressures, \*Underdeveloped countries.

This was the final paper presented at the international symposium, and the author summarizes the differences in problem perception between this symposium and a similar symposium on arid lands 14 years ago. The major difference is the shift in emphasis away from purely technological concerns with water development and agriculture toward the increasing realization that social problems are critical in resource development. Major social problems revolve around the grim fact of over-population combined with massive migrations from rural regions to urban areas, thus depriving rural regions of important segments of their population. Also, it is being learned that investments in education pay much higher returns than investments in structures. There have been many important advances in arid regions such as a rising tendency to

look for multiple solutions to resource problems, heightened attention to the ecological impacts of man's activities and increased scientific information flow. Nevertheless, the disparities in income between rich and poor countries are growing. Five major unresolved issues emerged at the symposium: (1) the importance of irrigation; (2) expansion vs. intensification of new development; (3) the value of single large projects compared to several small projects; (4) the role of amenities; (5) research in basic relationships vs. problem-solving. (Casey-Arizona) W71-08450

RESOURCES OF ARID SOUTH AMERICA, Universidad Agraria, Lima (Peru). Facultad de Ingenieria Agricola. Arturo Cornejo.

Presented at an international symposium, 'Arid Lands in a Changing World', Tucson, Arizona, June 1969. In: Arid Lands in Transition, Dregne, H E (ed), Pub No 90, AAAS, p 345-380, 1970. 16 fig,

Descriptors: \*Arid lands, \*Water resources, \*Climatic data, \*Natural resources, \*Water law, Geographical regions, Foreign lands, Deserts, History, Water resources development, Planning, Vegetation, Anticyclones, Ocean currents, Mountains, Economics, Rivers, Aquifers, Lakes, Groundwater, Reservoirs, Watersheds (Divides), Crops, Irrigation practices, Legal aspects, Water use, Water

Identifiers: \*Atacama Desert, \*Peruvian Desert, \*Chile, \*Peru, \*South America, Argentina, Brazil, Venezuela, Monte Desert, Patagonian Desert, South Pacific Anticyclone, Peruvian Current, Andean Cordillera, Coastal deserts.

The coastal deserts of Chile and Peru, the Atacama Desert of Chile, the Monte and Patagonian Deserts of Argentina and small regions of Brazilian northeast and coastal Venezuela constitute the major desert regions of South America. The great coastal desert and its interior region, the Atacama, are caused by the interacting effects of the South Pacific Anticyclone, the cold Peruvian Current and the limiting barrier of the Andean Cordillera. The coastal desert experiences fog and temperature constancy, both of which are absent from the Atacama. The mineral soil and offshore resources of these 2 deserts are described. The historical development of irrigation agriculture in the Peruvian Desert is reviewed and compared with modern agriculture in the area, where there are a large number of small rivers. The growing of rice in the Peruvian Desert resulting in drainage and salinity problems is an example illustrating the problem of introducing crops from humid areas into arid re-gions, resulting in poor use of limited water resources. Another problem is the building of large cities, such as Lima, on fertile valley soils. The natural regions of these deserts are described and needed research proposed. Actual and potential water resources are also considered in detail. The author feels that a new water law is needed in Peru. where agrarian reform signifies a rational redistribution of irrigation water rights. (Casey-Arizona) W71-08456

## GEOGRAPHIC CONSIDERATIONS IN PLANS FOR DEVELOPMENT, Hebrew Univ., Jerusalem (Israel). Dept. of Geog-

For primary bibliographic entry see Field 03F. W71-08459

### PRODUCTIVITY OF ARID AUSTRALIA,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Rangelands Research Unit. For primary bibliographic entry see Field 03F.

W71-08460

### **Group 6B—Evaluation Process**

## PUBLIC ACTION: REQUISITE FOR SUCCESS,

William E. Warne. Presented at an international conference, 'Arid Lands in a Changing World', Tucson, Arizona, June 1969. In: Arid Lands in Transition, Dregne, H E (ed), Pub No 90, AAAS, p 411-420, 1970. 8 ref.

Descriptors: \*Irrigation districts, \*Water contracts, \*Social aspects, \*Arid lands, \*Planning, California, Legal aspects, Economic efficiencies, Education, History, Water permits, Foreign lands, Water pol-icy, Water users, Public benefits, Governments, Ornization.

ganization.
Identifiers: \*Iran, \*California State Water Project, \*Dez Irrigation Project.

A crucial part of world food supplies are grown on irrigated lands, particularly in arid and semiarid regions. The production of such regions must be doubled, through creation of new water projects, by the year 2000. The construction of a water project involves physical and engineering problems in the planning and building of appropriate structures. Its efficient utilization involves the creation of appropriate social and legal institutions, such as irigation districts. The author maintains that the latter is too often neglected. The collapse of irriga-tion agriculture in ancient Mesopotamia and the difficulties of initiating water projects in 19th century California are cited as consequences of collapsing or badly-developed water institutions. By contrast, the successes of the California State Water Plan and the Dez Irrigation Project in Iran are described in detail to illustrate the importance of such institutions. Governmental stability, social innovation and user involvement are all vital ingredients in the creation of water project institutions. (Casey-Arizona) W71-08461

# HYDROLOGICAL RESEARCH IN SOUTH

University of the Witwaterstrand, Johannesburg (South Africa). Dept. of Civil Engineering.

D. C. Midgley.
South African Journal of Science, Vol 66, No 12, p 380-391, Dec 1970, 58 ref.

Descriptors: \*Hydrology, \*Surface waters, \*Groundwater, \*Research and development, \*Data collections, Floods, Droughts, Water resources, Evaporation, Silt, Streamflow forecast-

ing, Rainfall. Identifiers: \*South Africa.

In the past, practically throughout the entire subcontinent of southern Africa, hydrological research efforts have concentrated mainly on ad hoc problems within state organizations. More recently there has been an upsurge of interest in several state universities and among consulting civil engineers. Engineering problems associated with surface waters involve either too little or too much water. The research problems, measurement techniques, and accumulated data in South Africa are reviewed for streamflow, rainfall, flood studies, droughts, water resource surveys, evaporation and river silt loads. It appears that the combination of erratic rainfall, erratic river flow, high evaporation and heavy siltation calls for an enlightened philosophy of water resources development in the subcontinent. In view of the great reliance on groundwater in many areas there is surprisingly little research in groundwater hydrology. The greatest advances in data accumulation are likely to result from broad-scale coordination of information from scattered areas rather than from reliance on a few localized large hydrological research stations. (Casey-Arizona) W71-08466

## THE LITANI RIVER OF LEBANON: AN EXAM-PLE OF MIDDLE EASTERN DEVELOPMENT,

Morgan State Coll., Baltimore, Md. Dept. of Geography.
James Hudson.

Middle East Journal, Vol 25, No 1, p 1-14, Winter 1971. 1 fig, 23 ref.

Descriptors: \*Water resources development, \*Arid lands, \*Consumptive use, \*Water allocation (Policy), \*Cost-benefit analysis, Irrigation, Hydroelectric power, Thermal power, Urbanization, Water costs, Precipitation (Atmospheric), Evapotranspiration, Political aspects, Social aspects, Runoff, Economic feasibility.

Identifiers: \*Lebanon, \*Middle East, \*US Bureau of Reclamation.

Problems in the water resource development of the Litani Basin of Lebanon are typical of those in many similar basins of the arid Middle East. The major source of basin water is precipitation in nearby mountains, which is variable in time and amount. Over half is lost by evaporation and transpiration while the rest either appears as runoff or moves through groundwater channels to reach the river via springs. In the Basin as a whole, average annual flow is 700 million cubic meters. Flow variation is less marked than precipitation seasonality would suggest. The primarily urban uses of water (hydroelectricity, municipalities, industry and thermal cooling) are less consumptive than irrigation, thereby allowing for much greater reuse efficiency. This was made plain in a U.S. Bureau of Reclamation economic analysis in its plan for the Litani, which estimated the lower annual income and higher operating costs of an irrigation scheme as opposed to a hydroelectric scheme. When the Litani project was built, irrigation and municipal uses were deferred and so far only hydroelectric power has been produced. Although pressures are developing for irrigation water, the government has so far resisted them. This illustrates the problem of priorities in water development and the probable fallacies of the dream of Making the Desert Bloom. (Casey-Arizona) W71-08479

### THE SOIL AND WATER RESOURCES OF THE LOWER INDUS REGION

Sind Univ., Hyderabad (Pakistan). Dept. of Geography. M. M. Memon.

Oriental Geographer, Vol. 13, No. 1, p. 41-54, Jan 1969. 3 fig, 5 tab, 12 ref.

Descriptors: \*River basins, \*Surface waters, \*Groundwater, \*Irrigation efficiency, \*Water requirements, Water conservation, Aquifers, Soil types, Saline soils, Evapotranspiration, Water resources, Crop response, Productivity, Arid lands, Irrigation practices

Identifiers: \*West Pakistan, \*Indus River, \*Waterlogging.

Although the economy of West Pakistan is dominated by agriculture, irrigated crop yields are very poor and production/acre and production/capita steadily declined in the 1955-65 decade. This is particularly serious in view of the 2.38 percent/year population increase rate. Because the region is hot and arid, high evaporative demand requires an irrigation depth of 3.5 feet. Therefore, although about 13 million acres are available for cultivation, current water resources dictate a restriction to 7-8 million acres. Although the alluvial soils of the region are fertile, faulty irrigation and agricultural practices have resulted in water wastage, soil deterioration and aggravation of salinity and waterlogging problems. It is recommended that the poorer soils be withdrawn from production and surface and groundwater supplies be further developed and allocated only to the areas with the best soils, thereby allowing intensive cropping, increased use of fertilizers and other imputs. (Casey-Arizona) W71-08482

RETURNS FROM BEEF ON IRRIGATED PASTURES VS. RETURNS WITH OTHER CROPS,

Economic Research Service, Washington, D. C. Farm Production Economics Div; and Agricultural Research Service, Brookings, S. D.

For primary bibliographic entry see Field 03F. W71-08488

# THE URBAN SNOW HAZARD: ECONOMIC

THE URBAN SNOW HAZARD: ECONOMIC AND SOCIAL IMPLICATIONS, Illinois Univ., Urbana. Water Resources Center. Duane D. Baumann, and Russell Clifford. Available from the National Technical Information Service as PB-199 711, \$3.00 in paper copy, \$0.95 in microfiche. Water Resources Center, University of Illinois, Urbana, Research Report No 37, UILUWRC-71-0037, Apr, 1971. 149 p, 14 fig, 30 tab. OWRR Project B-032-ILL (1).

Descriptors: Snowfall, \*Cities, \*Social aspects, Evaluation, Costs, Urbanization, \*Decision making, \*Hazards, \*Snow management. Identifiers: Public service, \*Snow hazard.

The snowhazard is urbanized North America is small because snowfalls are frequent, recurring, and expected. The costs of adjustment are high, relative to other natural hazards, and the plattern of adjustments, public, are reasonably well or-ganized. The damage pattern is one of active disruption rather than one of death and destruction. A method was developed for use in informing municipal decisions concerning what is, in the northern tier of states, an expensive public service.

## METROPOLITAN WATER MANAGEMENT: CASE STUDIES AND NATIONAL POLICY IM-PLICATIONS.

Urban Systems Research and Engineering, Inc., Cambridge, Mass.

Available from National Technical Information Service as PB-199 493, \$6.00 paper copy, \$0.95 microfiche. Report NWC-EES-71-002, 1971. 456 p. National Water Commission Contract Number

Descriptors: Administrative agencies, \*Cities, Descriptors: Administrative agencies, \*Cities, \*Decision making, \*Economics, \*Government supports, \*Institutional constraints, \*Planning, \*Water policy, \*Water quality control, \*Water supply, Federal government, Forecasting, Institutions, Legal aspects, Massachusetts, On-site investigations, Operations, Personnel, Political aspects, Recreation, Sewage treatment, Sewerage, Social aspects, State governments, Texas, Washing. Social aspects, State governments, Texas, Washington, Water distribution (Applied), Wisconsin. Identifiers: Boston, \*Lubbock, \*Milwaukee, \*Seat-

A study of the planning, decision making, and implementation practices in urban-water management was made in 12 metropolises. Four were examined in detail onsite: Boston, Lubbock, Milwau-kee, and Seattle. Water supply, sewage collection, sewage treatment, water-quality control, and water-based economic and recreational activity were examined for range of objectives, technical and institutional approaches, exogenous influences, future problems and trends, and the effect of Federal policies. Specific recommendations for Federal action to improve financing, personnel practices, operations, availability of data and analyses, and the institutional and legal framework of water planning, decision making, and implementation are made. W71-08516

## NEED FOR WATER QUALITY DATA IN PLANNING WATER RESOURCE DEVELOP-MENTS.

Geological Survey, Lincoln, Nebr. Water Resources Div.

For primary bibliographic entry see Field 05A. W71-08558

# A RECREATIONAL BOATING POPULATION STATISTICAL INFORMATION SYSTEM,

Information Concepts, Inc., Arlington, Va. Gorman C. Smith, and Henry Linsert, Jr. Available from the National Technical Information Service as AD-723 739, \$3.00 in paper copy, \$0.95 in microfiche. Final Report Vol 1, Feb 1971. 380 p, 26 tab, 4 append.

Descriptors: Boats, \*Boating, \*Recreation, Recreational demand, Surveys, \*Census, Statistics, Population, Distribution patterns.

Identifiers: Boat accidents, Boat operators, Boating statistics, Recreational boating, Water safety.

This report describes Recreational Boating Activity in the 5th U.S. Coast Guard District-the District of Columbia and the states of Maryland, North Carolina, and Virginia--from 1 August 1969, through 31 August 1970. It summarizes the results of the fact finding phase of a Coast Guard effort to develop and test a Recreational Boating Population Statistical Information System. To improve knowledge for boating safety resources data and estimates were compiled on the characteristics of recreational boaters, the boats they use, and the various kinds of recreational boating activity they engage in. W71-08593

# THE VILENIN KARAKUM CANAL IN THE TURKMEN SSR.

For primary bibliographic entry see Field 03F. W71-08645

### ECONOMIC FACTORS IN THE DEVELOP-MENT OF A COASTAL ZONE,

Massachusetts Inst. of Tech., Cambridge J. W. Devanney, III, E. Debris, W. Seifert, and W.

Report No MITSG 71-1, 1970. Various paging.

Descriptors: \*Coasts, \*Economics, \*Water management, \*Cost-benefit analysis, Harbors, Government supports, Feasibility studies. Identifiers: \*Coastal zone development, \*Coastal zone management system, Lovel Island, Boston

Economic issues examined in the development of coastal zone include economic efficiency, failure of the private market to allocate the coastal zone efficiently, parochial benefits, inefficient local control, and the unpredictable future. Cost-benefit analysis is described, and practical problems and limitations involved in its application to the coastal zone examined by investigation of the development of Lovel Island in the Boston Harbor. Regionwide development strategies are explored, with coastal zone management system outlined. The key features of this system are: (1) provision of municipal services through user charges; (2) a state regulatory and enforcement agency; and (3) federal approach of state management plans enforced by federal funding of the state level organization. Final conclusions are that because private market and local control would not work, state and federal action for coastal zone development is essential; means for determining what is an efficient allocation of the shoreline can, for many decisions, be a properly developed and applied cost-benefit analysis. (McEntyre-PAI) W71-08753

### ECO-ENGINEERING - THE CHALLENGE OF RESOURCE DEVELOPMENT,

California Dept. of Fish and Game, Stockton. John E. Skinner.

Water Resources Bulletin, Vol 7, No 2, pp 355-367, April 1971.

Descriptors: \*Environment, \*Resource Develop-\*Ecology, Conservation, Aesthetics, Safety

Identifiers: \*Eco-engineering, Quality of life, Renewable resources, Regulatory agencies.

It is presumed that the present environmental thrust is not a wholly transitory fad; that there will be a residual impact on American society which will demand greater consideration in the future of ecological and environmental values by resource developers and public works agencies. An example is cited to show the validity of the environmental thrust and the severe consequences of ignoring it under the present emphasis on this aspect of resource development. An attempt is made to understand some of the reasons for the dramatic change in public attitude toward the environment and opposition to projects of apparent benefit to society. It is suggested that basic changes in society. It is suggested that basic changes in philosophy and concept will be necessary in the field of resource development. Some broad ecological and developmental guidelines are provided in the interest of implementing environmental considerations. Finally, those involved in resource development and public works are challenged to accept the concept of eco-engineering; a concept combining the competing elements of resource development and conservation. (Wray-Chicago) W71-08802

### PROJECT 2000, A PLANNING IMPERATIVE.

Bureau of Outdoor Recreation, Washington, D.C. Herbert M. Runkle, and Thomas H. Perkins. Water Resources Bulletin, Vol 7, No 2, pp 348-354, April 1971.

Descriptors: \*Planning, \*Social change, \*Decision making, \*Social aspects.
Identifiers: \*Social planning, Water Resources

Planning.

Wider social planning is badly needed for the pro-longed survival of man on the earth. Reasonableness requires blending of planning and construction--but a sharp line of independence is essential. Through intensive professional development and achievement of professional expertise, many outstanding technicians often move into vital decision making positions within their respective agencies. As planners, they see part of the action but miss the big picture. Problem solutions become restricted to agency or individual authorities and are not always the best alternatives. Thus, the planning field is overflowing with solutions to our every problem, but the solutions themselves often carry their own problems. (Wray-Chicago) W71-08803

## ARE SHORT-TERM ENVIRONMENTAL AC-TION PROGRAMS POSSIBLE-THE INLAND LAKE PROJECT EXPERIENCE,

Wisconsin Univ., Madison. Water Resources

Stephen M. Born.

Water Resources Bulletin, Vol 7, No 2, p 252-259,

Descriptors: \*Environment, \*Eutrophication, \*Lakes, Lake shores, Resource development. Identifiers: \*Upper Great Lakes Region, Inland Lake Demonstration Project, Snake Lake, Horseshoe Lake, Environmental problems.

A clear trend in recent years has been the increased public awareness of environmental deterioration and pollution. Society appears willing to support long-range fundamental research in environmental areas (such as eutrophication research) as long as action programs (such as lake renewal) are undertaken too. The experiences of the Inland Lake Demonstration Project afford an opportunity to evaluate one kind of short-term action-oriented response. The broad objectives of the Project have been the demonstration of techniques to restore, maintain, and protect a high quality environment in lakes and on shorelands within the Upper Great Lakes Region. Snake and Horseshoe Lakes were sites chosen for lake renewal activities. The most difficult problems of trying to execute short-term environmental programs is the frequent inadequacy of scientific knowledge to guide problem defini-tion, treatment selection, and prediction of results. (Wray-Chicago)

W71-08804

# WATER RESOURCES RESEARCH, A CHALLENGE TO THE SOCIAL SCIENTISTS.

Utah Water Research Lab., Logan. Dean F. Peterson.

Utah Water Research Laboratory, Utah State University, Occasional Paper 2, Logan, Utah, June

Descriptors: \*Water resources development, \*Social values, Decision making, \*Planning. Identifiers: \*Social scientists.

This paper deals with the role of engineers and social scientists in developing effective water resources plans. New standards are needed for making decisions about water resources. Planning requires all kinds of scientists, including social scientists. Relative values must be placed on water resource goals: conservation, aesthetics, improved living standards, etc. Decision making also involves the participants, and reaching a consensus of the majority without sacrificing minority needs. Water is a major resource with which man is concerned, and its development, therefore, must have some significant relationship to human institutions and values. In addition, technological and economic factors must be considered. For effective planning a team approach, with technologists and social scientists, holds the best possibilities. (Wray-Chicago) W71-08805

### FEDERAL ROLE IN THE URBAN ENVIRON-MENT,

Department of Housing and Urban Development, Washington, D.C.
Robert C. Wood.

Public Administration Review, Vol 28, No 4, p 341-347, Aug 1968.

Descriptors: \*Environment, \*Urban renewal, \*Urbanization.

Identifiers: Metropolitan areas, Model cities.

This paper deals with how the government can cope with the expected urban growth in this country. Starting in the 1930's, pressure mounted for federal urban representation. It culminated in 1965 in the Department of Housing and Urban Development. Various aspects of the Department's work include: (1) private mortgage market, (2) central city problems, (3) metropolitan areas and urbanizing countryside, (4) model cities and developmental work in intergovernmental relations. In addition to these program groupings, three steps were taken to assure a more effective Department: (a) consolidation of the Department's administrative function, (b) appointment of a deputy under secretary for policy analysis and program evaluation, (c) designation of a Budget Review Committee. With only a few years of operation, several trends are recognized--an integrated approach to urban problems, development of broader support bases, and strengthened legislative tools. It is hoped that with federal assistance in urban development new building techniques will emerge, land costs will be lowered, a wide range of housing designs will be provided, and new jobs will be created. (Wray-Chicago) W71-08806

## COMPLEMENTING PROCEDURES WITH SUBJECTIVE PRIORS IN WATER RESOURCES PLANNING,

Temple Univ., Philadelphia, Pa. Research Service.
P. Thomas Cox, and Bernard Siskin.

Water Resources Bulletin, Vol 7, No 2, p 368-375, Apr 1971.

\*Decision-making, Descriptors: \*Planning. \*Evaluation.

Identifiers: \*Stepwise multiple discriminant analysis, Water resource project, Prior probabilities.

### **Group 6B—Evaluation Process**

A procedure is outlined which allows consideration of both objective and subjective indicators to ostablish priorities in plan implementation of water resource development. The objective procedure utilizes stepwise multiple discriminant analysis to predict community performance regarding planned project implementation, based on previous project implementation in the Northeast. The subjective procedure incorporates prior probabilities developed by the planner, based on observation and experience gained through the planning The proposed analysis could eliminate waste through better allocation of planning funds to implementation studies exhibiting higher probability of early implementation. (Wray-Chicago) W71-08808

ROCKY MOUNTAIN URBAN WATER GOALS, American Society of Civil Engineers, New York. Urban Water Resources Research Program. M. B. McPherson.

Journal of American Water Works Association, Vol 63, No 3, p 176-180, Mar 1971. OWRR Project C-1536 (No 1992) (6).

Descriptors: \*Urban areas, \*City planning, \*Ur-

bescriptors: "Troal areas, "City planning, "Of-banization, Planning, Regions. Identifiers: "Rocky Mountain, "Urban water resources, Metropolitan areas, Comprehensive management, Regional development.

The author has attempted to indicate that while eastward Rocky Mountain states have been heretofore relatively unaffected by the burgeoning urbanization taking place in much of the rest of the United States, there is a high probability that emerging national policy on urban dispersion may cause in-migration that will result in much greater urban populations in those states than suggested by projections based on past and present trends. Comprehensive management of urban water resources is inhibited by: the fractionalized character of local government in metropolitan areas; the incomplete resolution of national policies on urban growth, water quality, and environmental quality; the absence of adequate information and data for satisfactory analysis of the urban system; incomplete valuation methodologies for waterresource planning and development; and a confusion of federal agency metropolitan programs. Much can be learned from others sharing similar problems, and the 'information explosion' should not be deplored but aggressively exploited. (Wray-Chicago) W71-08809

WATER RESOURCES DEVELOPMENT IN AN **ENVIRONMENTALLY-CONSCIOUS ERA,** 

Sierra Club, Los Angeles, Calif. Angeles Chapter. Alan Carlin.

Water Resources Bulletin, Vol 7, No 2, p 221-227, Apr 1971.

Descriptors: Environment, Economics, Taxes, Water rights, Inter-basin transfers, Conservation. \*Water resources developments, \*Evaluation. Identifiers: \*Environmental quality, Tax law, Sierra

The Sierra Club has come to the conclusion in recent years that much more basic reforms are required in water resources development activities if the demands for environmental quality now evidenced by the American people are to be satisfied. Among the urgent reforms with indirect effects are those involving revision of the procedures used in evaluating proposed projects. These procedures should be revised so that future evaluations will much more accurately reflect the economic and environmental merits of proposed projects. Basic reforms of tax policies are also needed that will eliminate most of the private profit available to those who can persuade the government to increase the value of their land through the construction of water projects. Finally, some additional actions can be taken that will have a direct impact on lessening the adverse environmental impact of water projects beyond the provisions of the National Environmental Policy Act of 1969. (Wray-Chicago) W71-08810

PROCEEDINGS OF A CONFERENCE ON WATER RESOURCES PLANNING AND PUBLIC OPINION.

Nebraska Univ., Lincoln. Water Resources Research Inst.

Available from the National Technical Information Service as PB-199 916, \$3.00 in paper copy, \$0.95 in microfiche. Conference held Mar 8-9, 1971, edited by Warren Viessman, Jr, Apr 1971. 80 p. OWRR Project A-999NEB (3).

Descriptors: \*Planning, Water resources development, \*Decision-making, \*Social aspects, Social values, Social participation, \*Public policy, Psychological aspects.

Identifiers: \*Public opinion, Public involvement, Environmental policy.

This conference was designed to acquaint water resources planners, managers, developers, researchers, and educators with public opinion. The conference dealt with such basic questions as: What is public opinion. How can planners assess it. In what ways can the planner take advantage of existing opinion. How can public opinion be shifted in favor of the planner's innovation. (See also W71-08812 thru W71-08814) W71-08811

PUBLIC DECISION-MAKER REPRESENTATIVE AND SPECIALIST: AN EXPLORATION IN LOW SALIENCE POLITICS, Florida State Univ., Tallahassee.

Norman Luttbeg.

In: Proceedings of a Conference on Water Resources Planning and Public Opinion, University of Nebraska, p 2-26, Mar 1971.

Descriptors: \*Decision-making, \*Public policy, \*Social aspects, Social values, \*Planning. Identifiers: \*Public opinion polls, \*Public involvement.

This paper looks at the public opinion polls and society's attitudes and participation in government in order to suggest methods applicable to decisionmakers in the area of water resource utilization. The most important element of information concerning public opinion is to identify those instances in which the public will permit a decision by professionals versus those in which they expect their elected representatives to be responsive to public opinion. Every effort to measure existent public opinion with survey research is recommended. Other ideas highlighted are that the public does not expect to be represented at all times; public policy need not always follow public opinion. Also, when seeking the adoption and public acceptance of water resource utilization proposals, the support of elected leaders is vital. (See also W71-08811) (Wray-Chicago) W71-08812

SOCIO-ECONOMIC RESEARCH WITHIN PUBLIC LAW 88-379.

Office of Water Resources Research, Washington,

Garland H. Hershey.

In: Proceedings of a Conference on Water Resource Planning and Public Opinion, University of Nebraska, p 69-76, Mar 1971.

Descriptors: \*Water resources development, \*Planning, Decision-making, \*Social aspects, Social values.

Identifiers: \*Socio-economic research, \*Public involvement, Interdisciplinary studies, Environmental policy.

This paper looks at the Water Resources Research Act of 1964 which created the Office of Water Resources Research. From its inception, the OWRR has been interested in carrying out socio-economic research in the water resources field. Top priority has been given to methodology and criteria for water resources planning. Interdisciplinary research is supported, especially that focusing on economic, political, social, legal, and organizational problems associated with the Nation's water future. Examples of some interdisciplinary projects and public opinion research are cited. Water resources research is continually interested in finding effective methods of involving an informed public in the decision-making process. (See also W71-08811) (Wray-Chicago) criteria for water resources planning. Interdiscipli-W71-08813

CHANGING PUBLIC OPINION: PROBLEMS AND PROSPECTS, Florida State Univ., Tallahassee.

Donald F. Smith.

In: Proceedings of a Conference on Water Resources Planning and Public Opinion, University of Nebraska, p 45-59, Mar 1971.

Descriptors: \*Decision-making, \*Social values, Social aspects, Psychological aspects, \*Planning, So-

cial participation.
Identifiers: \*Public opinion, \*Advertising, Mass

This paper deals with the success of advertising campaigns as a method of changing public opinion about governmental policy as it is applied to water resources development. It is suggested that many present advertisers were trained in the 1930-40-50's and utilize stimulus-reinforcement theories. The author's proposal is to consider any attempt to change public opinion as a diffusion process—a process in which a deliberate attempt is being made to diffuse throughout the public an acceptance of some new idea, proposal or practice. This concept views man as a creature that actively interacts with in-coming messages, selecting some, avoiding some, and modifying some. Second, this model views man in society as an intricate network of social relationships, many of which play a part in the process of framing and changing opinions. A basic result of research in this area has been the identification of a four-stage sequence through which individuals go as they come to accept something new. The first stage is awareness, second-interest, thirdevaluation, and four-decision. Some conclusions are (1) mass media alone is insufficient to change public opinion, (2) detailed grass-roots organizations in which individuals meet face-to-face are important, (3) there is need to construct messages to fit compatibly with existing opinions, (4) use of differing media and messages is helpful, (5) starting early to inform is advantageous. (See also W71-08811) (Wray-Chicago) W71-08814

# THE EAST-WEST WATER CONTROVERSY: BOTH SIDES ARE PARTLY RIGHT,

Stanford Univ., Calif.

R. K. Linsley.

Journal of the Sanitary Engineering Division, Proceeding of ASCE, Vol 93, No SA4, p 49-53,

Descriptors: \*Water management, \*Planning, resources, Economics, Projects, Downstream, Flood control, Navigation, Irrigation, Costs, Oceans, Deserts, Efficiencies, Hydrology, Conservation, Water pollution control.

Identifiers: Urban water supply, Sub-marginal farming, \*Rational basis, Comprehensive planning.

The purposes of this discussion was a concern shared mutually by both the East and the West that the other half of the country was not doing a very good job of water management. It pointed out that we should learn to deal with water development on a completely rational basis and that we lacked a coherent and rational national water policy. Some

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of the myths that surround the water problem was discussed. The most important myth that must be broken is that our major goal is the development of our water resources. There are many alternatives available to us. Instead of concentrating our research primarily on the structural features of hydraulic projects and on hydrology, we need to do some research in the area of conservation of water in the urban environment or on improving efficiency of water use in agriculture. We need to face squarely the economics of cost-sharing and reim-bursement between federal and local government.

### 6C. Cost Allocation, Cost Sharing, Pricing/Repayment

## WATER QUALITY MANAGEMENT AND A POLICY MODEL, Clemson Univ., S. C. Dept. of Environmental

Systems Engineering; and Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.

For primary bibliographic entry see Field 05G. W71-08499

#### **EARNINGS OF MUNICIPALLY OWNED UTILI-**TIES IN WISCONSIN,

Wisconsin Public Service Commission, Madison.

Journal American Water Works Association, Vol 52, No 2, p 162-169, Feb 1960. 1 tab, 3 fig.

Descriptors: \*Utilities, \*Profit, Operations, Maintenance, Depreciation, Public utilities, Costs, Rates, Payment, Revenues, Surveys, Capital, Debt, Construction costs, Expenditures, Wisconsin. Identifiers: \*Earnings, \*Dividends, \*Tax equivalent, Disbursements, Stockholders, General fund, Current ratio, Liabilities.

Income of a public utility owned by a municipality must first be used for operational, maintenance, depreciation, interest, local and school tax equivalents, additions, improvements, and other necessary disbursements, and indebtedness. Income in excess of these requirements may be used to purchase certain specified interest-bearing bonds or insurance on the life of an officer or manager of the utility, or may be paid into the general fund. Payments into the general fund are comparable to dividends paid by a corporation to its stockholders. Items discussed included payments for utility service, tax equivalent, depreciation expense, return on rate base, dividends, current ratio, and general fund. Records of several municipally owned utilities that usually pay a dividend were studied in order to determine their financial picture and relationship between dividends paid and other demands on available funds. (Wang-Rutgers) W71-08817

#### RATES. AND ADVANCE REVENUES.

PLANNING, Alvord, Burdick and Howson, Chicago, Ill. L. R. Howson.

Journal American Water Works Association, Vol. 52, No 2, p 153-161, Feb 1960. 4 fig, 3 ref.

Descriptors: \*Revenues, \*Rates, \*Costs, Operation and maintenance, Depreciation, Growth rates, Financing, Construction, Capital investment, Dept, Commissions, Water quality, \*Planning, Iowa. Identifiers: \*Advance planning, \*Water utilities, Des Moines, Capital requirements, Rate schedule, Long-term bonds, Reproduction cost.

Advance planning of a water utility facilitates the financing of new construction from current revenues and results in a material saving in the cost of water service. Public water supplies must continue to grow, and the money necessary to finance that growth must come from water revenue. The

rates for water service should be set well in advance of their effective date and are intended to provide for the future. Future operation and maintenance costs vary greatly and must be considered in fixing future rates. In municipally owned utilities, estimates of the gross revenue requirement are based on: operation and maintenance costs, debt service on obligations outstanding and to be issued in the succeeding 3-5 years, a depreciation allowance, and estimated average annual capital additions for the next 5 years. The utilities could do well to finance construction with less borrowing, simply by more careful planning. (Wang-Rutgers) W71-08818

### 6D. Water Demand

### CHARACTERISTICS OF HOUSEHOLD WATER CONSUMPTION IN THREE NEW HAMPSHIRE COMMUNITIES.

New Hampshire Univ., Durham. Water Resources Research Center.

Richard A. Andrews, and Martha R. Hammond. Available from the National Technical Information Service as PB-199 706, \$3.00 in paper copy, \$0.95 in microfiche. New Hampshire University Water Resources Research Center Research Report No 3, Dec 1970. 21 p, 9 tab, 8 ref. OWRR Project A-018-

Descriptors: \*Water utilization, \*Domestic water, \*New Hampshire, \*Water users, Water demand, Water costs, Lawns, Utilities, Water management (Applied), Water requirements, Cities. Identifiers: \*Household water consumption.

Water use in 361 households in three communities in southeastern New Hampshire was studied to determine the quantity of water used, causes for variation in quantity, the factors affecting con-sumption, and the annual household expenditures for water. Water use per household ranged from 8,000 gallons per year to 383,000 gallons per year. The quantity of water used daily per capita ranged from 8 gallons to 263 gallons. Lawn watering was not a major use of water. Households use more water during summer than during winter. Waste water disposal systems (septic tank or community disposal systems) were not a significant determinant of water consumption. There is a fixed 'overhead' quantity of water used, with an incremental use for each additional person of about 30 gallons of water daily. The overhead and the increment are determined by the appliances and fixtures of the house. The influence of the number of persons in the household and the physical characteristics of homes were more useful statistical determinants of water consumption than the single determinant of house value. Household expenditures for water were found to be an insignificant item in family budgets. (Knapp-USGS) W71-08323

#### WATER IN THE SERVICE OF MAN.

University of the Witwatersrand, Johannesburg (South Africa), Dept. of Civil Engineering. D. C. Midgley.

South African Journal of Science, Vol 66, No 11, p. 350-358, Nov 1970.

\*Hydrological cycle, \*Planning, \*Consumptive use, \*Water properties, \*Water users, Water resources development, Irrigation, Cooling, Municipal water, Groundwater, Surface waters, Desalination, Arid lands, Water allocation (Policy), Water vapor, Multiple-purpose projects. Identifiers: \*South Africa.

Both groundwater and surface water are in limited supply in South Africa, and estimates of future use indicate the country is not far from full exploitation of current resources. The hydrological cycle is reviewed and it is shown that when water enters the vapor part of the cycle, it is 'lost' to man. Practically all uses of water entail some conversion to the vapor phase. It therefore follows that a fundamental precept of water planning philosophy in water-short countries should be that water must be diverted to as many uses as possible before being allocated to consumptive uses. This necessitates highly coordinated national multi-use planning. The traditional practice of industrial and power site locations near low cost water for consumptive use must be abandoned. Municipalities use 10-20% of their source water while irrigation and thermal cooling stations use 80-100%. All sectors should therefore be located and coordinated so that waters shared by them are utilized with optimal efficiency. In arid lands, value added from water consumption is 44-51 dollars/acre ft for irrigation, about 250 dollars for recreation and 3000-4000 dollars for industry. Irrigation development in such regions should be avoided, and industrial development encouraged. (Casey-Arizona) W71-08465

### ESTIMATED WATER USE IN NEVADA,

Geological Survey, Carson City, Nev.; and Nevada State Dept. of Conservation and Natural Resources, Carson City,
Thomas J. Smales, and J. R. Harrill.
Nevada Division of Water Resources Planning Report No 2, Jan 1971. 32 p, 6 photo, 16 tab.

Descriptors: \*Water utilization, \*Nevada, Consumptive use, Withdrawal, Groundwater, Surface waters, Municipal water, Domestic water, Irrigation water, Stock water, Water supply, Water resources development, Water management (Ap-plied), Planning, Water demand. Identifiers: Nevada, Water Plan.

Withdrawals of water in Nevada from wells, springs, streams and rivers have increased from about 4.1 million acre-feet in 1950 to about 4.6 million ac. ft. in 1969. Use of spring discharge dropped slightly during this period, mainly due to the effects of heavy pumping in Las Vegas and Pahrump Valleys. Stream and river diversions increased from about 3.9 million ac. ft. to about 4.0 million ac. ft., an increase of about 2 1/2 percent. Pumpage from wells has increased by more than ninefold - from 53,000 ac. ft. in 1950 to about 490,000 ac. ft. in 1969. Most future increases will probably be from pumping groundwater. Between 1965-69 annual withdrawals for irrigation increased by less than I percent and electric power generation by about 4 percent. By contrast, public supply withdrawal soared by about 45 percent, and self-supplied industrial use by about 25 percent. (Knapp-USGS) W71-08526

# BUILDING RELIABILITY OF PLANT, PEOPLE. AND SERVICE, Detroit Metropolitan Water Services, Mich.

For primary bibliographic entry see Field 05D.

### PROJECTED GROUNDWATER DEFICIENCIES IN NORTHEASTERN ILLINOIS, 1980-2020,

Illinois State Water Survey, Urbana. For primary bibliographic entry see Field 04B.

### 6E. Water Law and Institutions

#### GUIDELINES--WATER QUALITY MANAGE-MENT PLANNING.

Environmental Protection Agency, Washington, D.C. Water Quality Office.

Environmental Protection Agency, Water Quality Office, Wash, DC (Jan 1971). 30 p, 3 fig, 5 append.

Descriptors: \*Water resources development, \*Planning, \*Grants, \*Standards, Administrative agencies, Programs, Coordination, Economic efficiency, Management, Methodology, River basin development, Waste water treatment, Waste water

## Group 6E—Water Law and Institutions

(Pollution), Construction costs, Financing, Treatment facilities, Sewage treatment, Long-term planning, short-term planning, Non-structural alternatives, Federal project policy, Federal government, State governments, Local governments, Legal aspects.

Identifiers: Administrative regulations.

During the preparation of unified planning requirements for the Environmental Protection Agency ments for the Environmental Protection Agency Waste Water Treatment Works Construction Grant Program and the Housing and Urban Development Water and Sewer Facilities Grant Program, these Preliminary Planning Guidelines provide the basic considerations to be addressed in meeting the requirements of both organizations. The guidelines, applicable to planning agencies concerned with development of water quality management plans, delineate the general policies, procedures and requirements for development of the necessary plans, and the evaluation of the effectiveness of the developed plans, in meeting national water quality objectives. Primary emphasis is given to the actions necessary to implement current regulations, appended hereto, on grants for water pollution control. Procedures for the processing and coordination of plans are set forth, along with sample plans and organizational charts. Guidelines for the development of water quality management plans for basins and for metropolitan regional areas are delineated, including the methodology of quality prediction and strategies resulting in cost effective solutions for waste water disposal problems within the planning area. Procedures, criteria and responsibilities for EPA evaluation and acceptance of the plans and construction grant applications are defined and described. (Smiljanich-Florida) W71-08427

# WATER QUALITY CONTROL IN CALIFORNIA: A REGIONAL APPROACH,

Richard N. Schwartz. California, Western Law Review, Vol 7, No 1, p 138-160 (1970). 23 p, 136 ref.

Descriptors: \*California, \*Water quality control, \*Regional analysis, \*Water pollution control, Administration, Water management (Applied), Water quality, Water requirement, Supervisory control (Power), Pollution abatement, Local governments, Long-term planning, Integrated control measures, Water districts, Sewage districts, State jurisdiction, Non-structural alternatives, Political aspects, Regulation, Project planning, Legislation, Legal

Examined in this note are the difficulties confronting California's regional water quality control boards implementing regional water quality plans. Organizational structure, plan formulation, and enforcement procedures under current law are emphasized. Each of California's nine regional boards represents a major watershed. Regional planning establishes the following elements: (1) protected beneficial uses, (2) water quality objectives, and (3) implementation programs. Regional policy is implemented in a two-step process: (1) implementation of waste discharge requirements, and (2) imposition of legal sanctions enforcing discharge requirements. This reliance on abatement rather than preventative enforcement has rendered the multi-community approach adopted in one region ineffective. It has been suggested that regional boards be statutorily granted the authority to institute the consolidation, dissolution, or reorganization of sewerage districts. This would allow inter-community coordinated waste disposal and more effective long-range water quality planning.
Current statutory prohibitions upon board power to specify the means of waste discharge compliance is warranted. Allowing direct regional water quality control through sewerage district reorganization would make California's water quality system far more effective, (Earl-Florida) W71-08428

A BILL TO AMEND THE CLEAN AIR ACT AND THE FEDERAL WATER POLLUTION CONTROL ACT TO PROVIDE FOR STANDARDS FOR THE MANUFACTURE OF CERTAIN PRODUCTS TO PROTECT THE QUALITY OF THE NATION'S AIR AND NAVIGABLE WATERS.

Senate Bill 573, 92d Cong, 1st Sess (1971). 20 p.

Descriptors: \*Industrial production, \*Pollutant identification, \*Water pollution control, \*Legislation, Legal aspects, Federal jurisdiction, Federal government, Water pollution sources, Chemical wastes, Non-structural alternatives, Industrial wastes, Organic compounds, Institutional contents to Noticephe uniter. Water applies posteriors straints, Navigable waters, Water quality control, Administrative agencies, Administrative decisions, Environmental effects, Analytical techniques, Path of pollutants, Toxins, Supervisory control (Power), Standards, Regulation, Air pollution. Identifiers: \*Federal Water Pollution Control Act,

\*Clean Air Act.

Authorizing the implementation of standards for substances utilized in manufacturing processes, this bill would amend both the Federal Water Pollution Control Act and the Clean Air Act. The bill's purpose is the protection of the nation's air and navigable waters. The Administrator of the Environmental Protection Agency is required to designate sub-stances used in manufacturing which adversely affect public health or violate air or water quality standards. Prior to the introduction of any previously unused manufacturing substance, the manufacturer would be required to: (1) provide the name, concentration, purpose, and chemical composition of such substance; (2) conduct health tests; (3) supply all available information relating to environmental effects of the substance; and (4) describe techniques for detecting such substance. The Administrator would prescribe utilization standards whenever a substance might result in adverse discharges into the air or navigable waters. Such standards must include testing techniques and reporting requirements. The manufacture, import, or export of products not conforming to promulgated standards would be unlawful. Products which fail to conform to appropriate standards would be subject to libel, seizure, and condemnation Judicial procedures, including criminal contempt and injunctive measures, would be governed by procedures set forth in the bill. (Earl-Florida) W71-08429

# CALIFORNIA'S TIDELAND TRUST: SHORING

IT UP, Peter C. Davis.

Hastings Law Journal, Vol 22, No 3, p 759-781 (1971). 23 p, 160 ref.

Descriptors: \*California, \*Coasts, \*Land use, \*Environmental effects, Beds, Ownership of beds, Public rights, Public benefits, Wetlands, Tidal marshes, Tidal waters, Coastal marshes, Shores, Water resources development, Human population, Administration, Damage, Balance of nature, Ecology, Exploitation, Community development, Preferences (Water rights), Legal aspects, Legislation, Judicial decisions.

Traditionally limited to promoting commercial, fishing, and navigational interests, California's tidelands trust is explored in this article as a vehicle to protect tideland ecological integrity. The public trust doctrine evolved through Roman, English, and American law. The development of the trust in California resulted from legislative actions and judicial construction. The terms of the trust are analyzed and set forth in eleven points by the author. Enforcement of the trust by both the state and private citizens is examined. Historically, trust administration has been characterized by an ecologically unsound promotion of commercial interests. Precedent exists for reappraising the trust's 'public interest' concept in terms of environmental quality. Recent California legislation should provide the courts with a mandate for such a reappraisal. A new approach is needed to put commercial tideland projects into perspective. Environmental advocates will attempt to expand the trust. If the courts listen, the legacy of past ecological abuse need not be accepted in the future. (Earl-W71-08430

FIRST ANNUAL REPORT ON THE STATE OF THE NATION'S ENVIRONMENT--MESSAGE FROM THE PRESIDENT OF THE UNITED STATES, Richard M. Nixon.

117 Cong Rec 505-512 (daily ed Feb 18, 1971). 8

Descriptors: \*Environment, \*United States, Water pollution control, \*Non-structural alterna-\*Water pollution control, \*Non-structural alterna-tives, Federal government, Planning, Administra-tive agencies, State governments, Local govern-ments, Water pollution, Pollutants, Pollution abatement, Air pollution, Land use, Land resources, Water resources, Water resources development, Parks, Recreation, Water pollution sources, Taxes, Ecology, Federal project policy, Pesticides, Legislation. Identifiers: \*Presidental messages.

This President's Report on the State of the Environment is divided into six parts. Part One considers strengthening of pollution control programs and proposes corrective measures including: charges on sulfur oxides and leaded gasoline, water pollution controls, pesticide control authority, and a federal procurement program for paper recycling. 'Controlling Emerging Problems' is the topic of part two, which proposes regulation of topic or part two, which proposes regulation of toxic substances, regulation of noise pollution, and controls on ocean dumping. To promote environmental quality in land use decisions, the President proposes in part three: (1) a national land use policy; (2) an open space and recreational program, bringing parks to urban areas; (3) preservation of historic buildings though two languages. historic buildings through tax policy; (4) expansion of the wilderness areas preservation system; (5) public agency approval of power transmission line routes; and (6) mining regulations. In part four, expanded international cooperation and a world heritage trust are proposed. Establishment of an environmental institute is recommended in part five. In part six, the role of the individual citizen in improving the environment is stressed. (Hart-W71-08431

#### A BILL TO PRESERVE AND PROMOTE THE RESOURCES OF THE CONNECTICUT RIVER VALLEY.

Senate Bill 36, 92d Cong, 1st Sess (1971). 14 p.

Descriptors: \*Connecticut, \*Legislation, \*National historic parks, \*National recreation areas, Vermont, New Hampshire, Massachusetts, Federal government, State governments, Local governments, Administration, Regulation, Administrative agencies, National parks, Public lands, Federal reservations, Recreation, Conservation, Ecology, Rivers, Interstate rivers, River basins, Compensation, Condemnation value, Land tenure, Legal

The Connecticut Historic Riverway would be established by this proposed bill. Under the bill, the United States shall preserve the natural ecological environment of the Connecticut River Valley Corridor, develop the recreational potential of the area, and encourage maximum complementary action by state and local governments and private individuals, groups and associations. The bill provides for the acquisition of title to lands and of scenic easements. Provisions for the taking of private land as well as the rights of the private holders are specified. Regulations shall be issued to carry out the provisions of this bill, but such regulations shall not discourage the constructive development and use of land for industrial and commercial purposes which are consistent with the purposes of

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this bill. The duties and responsibilities of the Secretary of the Interior, Federal Power Commission, National Park Service, Secretary of Agriculture, and Secretary of the Army are detailed. The Connecticut Historic Riverway Advisory Committee is established by the bill, and its membership is explained. (Robinson-Florida) W71-08432

A BILL TO AMEND THE ACT OF MARCH 3, 1899, RELATING TO PENALTIES FOR WRONGFUL DEPOSIT OF CERTAIN REFUSE, INJURY TO HARBOR IMPROVEMENTS, AND OBSTRUCTION OF NAVIGABLE WATERS. Senate Bill 679, 92d Cong, 1st Sess (1971). 2 p.

Descriptors: \*Coastal structures, \*Engineering structures, \*Legislation, \*Federal government, Coastal engineering, Financing, Rivers, Harbors, Legal aspects, Public rights, Public benefits, Federal jurisdiction, Water policy, Damages, Wastes, Waste disposal, Waste dumps.

Section 16 of the Act entitled 'An Act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes' (33 USC 411) shall be amended by striking out in the first sentence thereof the following: 'twenty-five hundred dollars', and adding in lieu thereof '\$100,000', and by placing immediately after this first sentence the following new sentence: 'In the case of any violation which continues over a period of time, each day such violation continues shall be a separate violation for the purposes of this section.' (Robinson-Florida) W71-08433

A BILL TO PROVIDE THAT STATE LAWS OR REGULATIONS WITH RESPECT TO CERTAIN ENVIRONMENTAL MATTERS SHALL NOT BE PREEMPTED OR NULLIFIED BY FEDERAL LAW.

Senate Bill 675, 92 Cong, 1st Sess (1971). 1 p.

Descriptors: \*Environment, \*Water pollution, \*Water pollution control, \*Legislation, Air pollution, Legal aspects, Federal government, State governments, Local governments, Regulation, Water law, Pesticides, Herbicides, Waste disposal, Wastes

Under this proposed legislation no provision of federal law shall preempt or nullify any state law, local ordinance, or regulation for the prevention or regulation of air or water pollution, noise, the use of pesticides or herbicides, or the disposal of solid waste until such time as regulations in lieu of such state law or regulation are put into effect by or pursuant to federal law. (Robinson-Florida) W71-08434

VIOLATIONS OF LAWS PROTECTING NAVIGABLE WATERS.
Corps of Engineers, Washington, D.C.

33 Code of Federal Regulations, Sec 209.170 (1970). 5 p.

Descriptors: \*Rivers and Harbors Act, \*Navigation, \*Administration, \*Navigable waters, Legal aspects, Legislation, Hazards, Accidents, Ships, Harbors, Adoption of practices, Water quality control, Water pollution control, Pollution abatement, Pollutant identification, Abatement, Water quality, Administrative agencies, Supervisory control (Power), Tidal waters, Structures, Construction, Waste disposal, Regulation, Federal jurisdiction. Identifiers: Administrative regulations.

The substance, enforcement procedures, and penalties for violation of statutes protecting navigable waters are herein outlined. Constructing structures over or in navigable waters requires local permission and Corps of Engineer plan approval. Department of Transportation approval is required for

bridges and causeways. The Secretary of the Army's navigational authority extends to artificial islands and outer continental shelf structures. Statutes governing wrecks in navigable waters for-bid such activities as: (1) obstructing navigable channels, (2) permitting or causing vessels to be sunk in navigable waters, and (3) the floatation of certain materials in navigated channels. Owners of sunken vessels are required to properly mark such craft. Willful or negligent actions causing vessels to be sunk constitute a misdemeanor. Injury to government works related to navigation is prohibited. The discharge or deposit of refuse matter into or on the banks of navigable waters, tributaries thereof, or certain tidal waters is forbidden. Penalties and enforcement procedures provided in statutes protecting navigation are herein detailed. District Engineers will note and secure enforcement of violations in his district. Such matters will be referred to the Chief of Engineers where parties deny or continue violations. (Earl-Florida) W71-08435

# OPERATION AND MAINTENANCE OF BEAR CREEK DAM AND RESERVOIR.

Code of Federal Regulations, Title 33, Ch 2, Sec 208.31 (1970). 2 p, 1 tab.

Descriptors: \*Missouri, \*Dams, \*Reservoirs, \*Reservoir operation, Reservoir storage, Water resources development, Projects, Regulations, Maintenance, Flood control, Flood damage, Water Levels, Water level fluctuations, Water management (Applied), Recreation, Water conservation, Federal government, Cities, Spillways, Engineering structures, Construction, Streams, Streamflow, Discharge (Water).

Having completed the Bear Creek dam and reservoir project in Missouri, the United States Army Corps of Engineers turned it over to the city of Hannibal, Missouri, to be operated and maintained through a superintendent employed by the city in accordance with this regulation. In order to control floods, water levels are prescribed. Water may not be stored to create or maintain a conservation or recreation pool. The superintendent shall regulate the reservoir so as to reduce as much as possible flood damage below the reservoir. The regulation prescribes in what situations water may be released from the reservoir. The superintendent shall operate and maintain the reservoir in accordance with the Corps' manual. He shall furnish the District Engineer with reports on the operation and condition of the dam and with hydrological data as called for. A table prescribes water elevations for the reservoir. The regulations are subjected to temporary modification by the District Engineer in time of emergency. (Duss-Florida) W71-08436

SANTA BARBARA CHANNEL OIL LEASES, Richard Nixon.

116 Cong Rec H 5439 (daily ed), 6 US Code Cong and Admin News, p 1950-1951 (1970). 2 p.

Descriptors: \*California, \*Water pollution sources, \*Wildlife conservation, \*Oil industry, Oily water, Pacific Ocean, Channels, Sea water, Legislation, Leases, Oil wells, Exploration, Oil, Oil fields, Drilling, Oil reservoirs, Exploitation, Marine geology, Oceans, Water pollution, Aquatic environment, Pollution abatement, Wildlife management, Federal government, Legal aspects. Identifiers: Oil leases, Presidential messages.

The President of the United States herein submits to Congress a special message requesting legislation to terminate oil exploration leases in the Santa Barbara Channel and to create a marine sanctuary. The State of California had attempted to protect a part of its coastline by creating a state sanctuary and closing it to all petroleum exploration. The federal government, however, subsequently issued leases for petroleum exploration immediately seaward from the state sanctuary. A blowout in the

Channel resulted in widespread oil pollution of the sanctuary. Legislation being submitted would terminate all but three leases and create a marine sanctuary. The continuation of the three leases is necessary to avoid further marine pollution as high pressure oil would escape through zones of structural weaknesses if not bled off. These leases would continue under strict management controls. This recommendation is based on the belief that immediate economic gains are outweighed by considerations of wildlife preservation and the quality of life in America. (Smiljanich-Florida) W71-08437

AN ACT RELATING TO THE ESTABLISHMENT AND IMPLEMENTATION OF PUBLICLY FINANCED EROSION CONTROL AND BEACH RESTORATION PROJECTS.

Florida Laws Ch 70-276, p 869-876 (1970).

Descriptors: \*Florida, \*Beach erosion, \*Boundaries (Property), \*Erosion control, Beaches, Riparian land, Beds, Beds under water, Relative rights, Shore protection, Washouts, Real property, Land tenure, Riparian rights, Priorities, Coastal engineering, Administration, Administrative decisions, Adoption of practices, Ownership of beds, Tidal effects, Land management, Administrative agencies, State governments, Legislation, Legal aspects.

Publicly financed beach nourishment and restoration programs are hereby declared to be in the public interest. Upon request for such programs, the Trustees of the Internal Improvement Fund shall require the Department of Natural Resources' approval or disapproval. In determining project priority, the Trustees shall consider relative needs, equipment availability, and federal and local contributions and cooperation. The Trustees shall conduct a survey establishing the restoration area and an erosion control line. No control lines shall be established absent the consent of a majority of affected riparian owners. To receive evidence as to the merit of a project, the Trustees shall, after notice, hold a public hearing. On motion of aggrieved persons, Trustee decisions shall be judicially reviewable. Title to lands seaward of the erosion control line shall be deemed in the state upon the filing of the Trustee's resolution and recording of the erosion control line. Common law principles shall not subsequently alter upland property proportions, but persons divested of riparian title shall continue to enjoy all other riparian rights. Under conditions herein specified projects may be cancelled and established erosion control lines may be voided. (Earl-Florida) W71-08438

AN ACT TO PROVIDE THAT A RIPARIAN OWNER SHALL CONSENT BEFORE DREDGING MAY BE DONE FOR A PUBLIC PURPOSE.

Florida Laws Ch 70-147, p 497-498 (1970) amending Fla Stat sec 253.12 (5). 2 p.

Descriptors: \*Florida, \*Riparian land, \*Riparian waters, \*Dredging, Real property, Land tenure, Relative rights, Riparian rights, Navigable waters, Riparian water loss, State governments, Local governments, Eminent domain, Construction, Public rights, Earthworks, Channel improvement, Excavation, Beaches, Erosion control, Beach erosion, Legal aspects, Legislation, Constraints, Drainage programs.

An amendment to an existing chapter of legislation, this act provides that nothing in the chapter shall be construed to permit any state agency, county, city, or political subdivision to conduct construction or extension operations on lands bordering or in navigable waters, nor to drain such waters, unless such agency is or holds the written consent of the upland riparian owner as herein defined. However, nothing in this amendment shall limit the right of eminent domain concerning such projects. This

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amendment shall not be applicable where the Trustees of the Internal Improvement Fund are authorized to establish erosion control lines to implement beach nourishment, replenishment, or erosion control programs. (Earl-Florida)

## AN ACT ESTABLISHING THE FLORIDA EN-VIRONMENTAL INVENTORY COUNCIL. Florida Laws ch 70-316, p 945-949 (1970).

Descriptors: \*Florida, \*Resource allocation, \*Ecological distribution, \*Administrative agencies, Legislation, Water resources, Land resources, Natural resources, State governments, Wildlife, Grasslands, Forests, Conservation, Resources, Resource development, Soil conservation, Inspection, Environments, Administration, Coordination, Evaluation, Animal populations, Aquatic life, Beaches, Census, Plant populations.

The Florida Environmental Inventory Council is hereby created as an advisory council to the Department of Natural Resources. The Council's membership shall consist of the administrative heads of: (1) the departments of Commerce, Transportation, Health, and Rehabilitative Services, Air and Water Pollution Control, Agriculture and Consumer Services, Administration, and Natural Resources; (2) the Public Service Commission, Game and Fresh Water Fish Commission, and Trustees of the Internal Improvement Trust Fund; and (3) five citizens nominated by the governor. It is the intent of the legislature to create the Council for a three-year period to advise the Department concerning an environmental inventory of Florida's natural resources. Under authority herein detailed, the Department shall develop and conduct such an inventory containing a statement of present resource use and affected environmental factors. Included in coastal area inventories shall be: (1) submerged or exposed, grassy productive areas; (2) algae-covered areas; (3) salt-loving plants; (4) estuarine areas; (5) salt water aquatic life; and (6) beach topography and stability. Watershed quality, stream circulation, and fresh water aquatic life shall be included in inland water inventories. Included in inland inventories shall also be: natural vegetation areas, soil quality and stability, and wildlife. (Earl-Florida) W71-08440

## THE FLORIDA WATER POLLUTION CON-TROL AND SEWAGE TREATMENT PLANT GRANT ACT OF 1970.

Florida Laws ch 70-251, p 769-775 (1970).

Descriptors: \*Florida, \*Water pollution control, \*Treatment facilities, \*Grants, Water pollution treatment, Waste treatment, Sewage treatment, Sewage disposal, Sewage, Sewage districts, Local governments, State governments, Federal government, Legislation, Legal aspects, Project planning, Water quality control, Adoption of practices, Administrative agencies, Payment, Administration, Financing construction costs, Capital costs, Cost

The Florida Water Pollution Control Trust Fund is hereby established to be used for grants to local governmental agencies for sewage treatment facility construction. The Florida Air and Water Pollution Control Board shall implement this act and administer appropriated funds. Grants shall be made only to projects eligible for federal grants. No grants shall be made unless a facility is approved by, and subject to, Board-imposed conditions. The local agency must agree to pay costs exceeding state and federal grants. Grants shall not exceed 25% of costs eligible for federal grants. The local agency must adopt and submit for approval a comprehensive long-range water pollution control plan. This plant shall: (1) provide for construction preventing inadequately treated waste discharge; (2) provide planning, zoning, population projection, engineering, and economic studies; (3) comply with the state population control plan; (4)

set forth timing, financing, construction, and operating proposals; and (5) be reviewed by local planners. The Board may administer planning grants and provide coordinating technical assistance. Projects shall be funded in order of priorities established by the Board. The Board may advance funds equal to approved, but not yet available, federal grants. (Earl-Florida)

AN ACT AUTHORIZING DRAINAGE, WATERSHED IMPROVEMENT, AND SOIL CONSERVATION DISTRICTS TO ENTER INTO AGREEMENTS WITH THE UNITED STATES FOR THE CONTRACTING OF IMPROVEMENT

Act 152, Acts of Arkansas, p 440-443 (1969). 4 p.

Descriptors: \*Arkansas, \*Water districts, \*Contracts, \*Construction, Drainage districts, Watershed management, Soil conservation, Bids, Institutional constraints, Projects, Federal government ment, United States, Construction costs, Engineering structures, Administrative agencies, Legislation, State governments, Legal aspects.

Three prior acts are hereby amended to authorize drainage districts, watershed improvement districts, and soil conservation districts to enter into contracts with the United States for the construction of improvement works and awarding of contracts therefor. The construction of the improvements and the awarding of contracts are to be by, and under the control and supervision of, the United States or any of its agencies. The advertisement, award, and carrying out of the contracts shall be in accordance with the applicable federal agency laws. (Smiljanich-Florida) W71-08442

### POLITICS OF WATER,

Colorado State Univ., Fort Collins. Dept. of Political Science.

Presented at an international symposium, 'Arid Lands in a Changing World,' Tucson, Arizona, June 1969. In: Arid Lands in Transition, Dregne, H E (ed), Pub No 90, AAAS, p 165-173, 1970. 4 ref.

Descriptors: \*Political aspects, \*Social impact, \*Water law, \*Water policy, Water resources development, Decision making, Water rights, Environmental effects, Social values, Institutions, Political constraints Identifiers: \*Oases.

The populations of arid lands may be divided into 2 major groups: (1) a small diffuse rural population, diminishing in both size and importance in most narapidly growing, which control national politics. In areas of water scarcity, water may be allocated through the use of force, the market system, or the political system. Though often camouflaged, force is used extensively. Because of the necessity of high risk capital and limited profits the market system is inefficient and usually gives way to political alloca-tion. Rapid growth of oasis communities, intensification of the problems of population concentra-tion, and development of new uses for water--all significant environmental changes associated with an affluent society--will inevitably create further demands on such a political water system responsive to economic growth forces and demands for protection of existing rights. (Casey-Arizona) W71-08452

## FLORIDA AQUATIC WEED CONTROL ACT.

Fla Laws ch 70-203, p 613-616 (1970) 4 p.

Descriptors: \*Florida, \*Aquatic weeds, \*Water pollution control, \*Aquatic plants, Legislation, Public health, Recreation, Water hyacinth, Administrative agencies, Research facilities, Financing, Costs, United States, Natural resources, Water resources development, Permits.

Authorizing the Florida Department of Natural Resources to direct state activities relating to aquatic plant control, this Act and amendments to existing Florida statutes outline the department's duties and provide for coordination with other administrative agencies. The basic public policy is to vest authority for aquatic plant control in the Department so as to protect human health, safety, and recreation and to as far as possible prevent injury to plant and animal life and property. It is the Department's duty to coordinate the aquatic weed control activities of all public agencies. It may delegate these functions to the Division of Game and Fresh Water Fish. The Department shall also have responsibility for promoting, developing, and supporting research activities relating to aquatic plant control. The Department's powers in this area are outlined. The Act also delineates the procedures whereby the Department may disburse funds to local agencies for aquatic plant control. An amend local agencies for aquatic plant control. An amendment to the Florida statute on hyacinth control gives the Florida Game and Fresh Water Fish Commission the authority to cooperate with the United States with respect to hyacinth eradication, subject to the rules and regulations of the Department. (Duss-Florida) W71-08502

# METROPOLITAN WATER MANAGEMENT: CASE STUDIES AND NATIONAL POLICY IM-

Urban Systems Research and Engineering, Inc., Cambridge, Mass.
For primary bibliographic entry see Field 06B. W7i-08516

# A CONSIDERATION OF FEDERAL FINANCIAL INCENTIVES TO INDUSTRY FOR ABATING WATER POLLUTION.

League of Women Voters, Washington, D.C. For primary bibliographic entry see Field 05G.

# A BILL TO AMEND THE FEDERAL DISASTER ACT TO PROVIDE ASSISTANCE FOR THE REHABILITATION AND RECONSTRUCTION OF AREAS DAMAGED BY FLOODS AND HIGH WATERS.

Senate Bill 1793, 89th Cong, 1st Sess (1965).

Descriptors: \*Floods, \*Flood damages, \*Compensation, \*Disasters, Government finance, Floodwater, Flood protection, Water injury, Damages, Water level fluctuations, Property values, Land reclamation, Rehabilitation, Construction, Grants, Financing, Debt, Loans, Projects, Urban renewal, Flood plain insurance, Insurance, Administrative agencies, Federal government, Legislation, Legal aspects.

Identifiers: \*Federal Disaster Act.

In response to extensive property loss and severe damage often resulting from floods and high waters, the Federal Disaster Act would be amended by this proposed legislation to provide assistance for the rehabilitation and reconstruction of damaged areas. Federal-aid highway systems damaged by floods and high waters would be repaired or reconstructed with federal money. The Secretary of Agriculture would be authorized to compromise or release borrower indebtedness under various administrative programs as he finds necessary because of losses resulting from floods and high waters. The Housing and Home Finance Administrator would also be authorized to com-promise or release specified indebtedness and could issue urban renewal project grants for reconstruction and redevelopment of damaged lands. other necessary civil works projects by the Corps of Engineers would be authorized by the Act. Provisions would be made for federal assistance to riotsions would be made for receival assistance to states for the retiring or adjustment of private mortgage obligations. Regulative provisions under the Act would take into consideration the reasonable foreseeability of loss by floods or high waters in the affected areas, the availability and presence of

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indemnification, and the applicant's failure to take adequate precautions against the damage. (Smiljanich-Florida) W71-08563

A BILL TO AMEND THE OIL POLLUTION ACT TO IMPLEMENT THE PROVISIONS OF THE INTERNATIONAL CONVENTION FOR THE PREVENTION OF THE POLLUTION OF THE SEA BY OIL.

Senate Bill 2017, 89th Cong, 1st Sess (1965).

Descriptors: \*International waters, \*Waste disposal, \*Ships, \*Oily water, Oil, Oil wastes, Water pollution sources, Water pollution, Waste dumps, Pollution abatement, Pollutants, Water pollution control, Water quality control, International law, Oil industry, Treaties, Federal government, Legislation, Legal aspects.

In order to implement the provisions of the International Convention for the Prevention of the Pollution of the Sea by Oil, the Oil Pollution Act of 1961 proposed legislation. The definitions of the terms 'oil' and 'ship' would include: would be amended in several respects by this and 'ship' would include specified distinctions and certain ships would be expected from the provisions of the Act. A new provision would incorporate the definition of the term 'from the nearest land' as defined in the Convention. Under the Act, as amended, the discharge of oil or oily mixture from specified ships and tankers would be prohibited or subject to prescribed regulations. Certain discharges, however, would be excepted from the prohibition. The zone of prohibition would include all sea areas within fifty miles from the nearest land, subject to extensions or reductions effectuated in accordance with the terms of the Convention. Provisions would be made for the maintenance of oil record books by every ship and tanker subject to the Act. Such books would contain detailed records of any discharge of oily water. (Smiljanich-Florida) W71-08578

### ACCRETION AND RECLAMATION.

In: Florida Real Estate Law and Procedure, The Harrison Company, Atlanta, p 1595-1616 (1960). 16 p, 45 ref.

Descriptors: \*Florida, \*Accretion (Legal aspects), \*Bank erosion, \*Avulsion, Riparian rights, Riparian land, Riparian waters, Boundaries (Property), Boundary disputes, High water mark, Navigation, Navigable waters, Streams, Rivers, Ownership of beds, Land tenure, Real property, Bulkhead, Landfills, Bulkhead line, Legislation, State governments, Legal aspects.

The following terms are defined in the first section of this article dealing with accretion and reclamation: (1) accretions, (2) alluvion, (3) reliction, (4) avulsion, and (5) erosion. The second section, entitled 'accretions and relictions', considers the title to soil formed or exposed by the natural action of the water or by receding waters. The common law rule is expressed and stated to be applicable in Florida. Whether title to accretions or relictions passes in a conveyance of the riparian tract is discussed. Several Florida decisions which are particularly applicable to the doctrine of accretions and relictions are analyzed. Whether the cause of accretion or reliction affects the general rules is also discussed. The remaining section considers the reclamation of riparian land. Provisions of state legislation permitting bulkheads and fills are extensively discussed, along with the rights of contiguous riparian owners. Also, decisions construing provisions of the applicable statute are analyzed. (Hart-Florida) W71-08596

SQUAW ISLAND FREIGHT AND TERMINAL CO V CITY OF BUFFALO (PRIOR NOTICE

REQUIREMENT FOR POLLUTION SUIT AGAINST CITY). 133 Misc 64, 231 NYS 139-145 (Sup Ct 1928).

Descriptors: \*New York, \*Sewage, \*Water pollution, \*Adjudication procedure, Water pollution sources, Rivers, Damages, Sewers, Overflow, sands, Gravels, Islands, Land, Land tenure, Cities, Sewage disposal, Legal aspects, Judicial decisions.

Plaintiff sand and gravel company sought to restrain defendant city from continuing to discharge sewage into a river. Plaintiff also sought to recover for damages to plaintiff's property caused by the sewage already discharged by defen-dant. Plaintiff owned land on an island from which it took sand and gravel. It alleged that defendant's sewage had formed a margin around the island and covered the surface of the island, thereby rendering the sand resources worthless. Defendant contended that plaintiff had not followed the requisite procedure for suing the city in that the charter required that no action on a claim could be brought against the city until the expiration of forty days after the filing of the claim with the city council. The supreme court agreed with defendant's contention and dismissed plaintiff's complaint without predjudice. (Duss-Florida) W71-08602

ROSSI V CITY OF SCHENECTADY (CONDI-TIONS PRECEDENT TO SUIT AGAINST MU-NICIPALITY FOR FAULTY SEWERS). 133 Misc 792, 233 NYS 512-515 (Sup Ct 1929).

Descriptors: \*New York, \*Flood damage, \*Storm drains, \*Adjudication procedure, Local governments, Sewers, Sewage, Floods, Floodwater, Surface runoff, Surface waters, Surface drainage, Damages, Storm runoff, Water injury, Legislation, Judicial decisions, Legal aspects.

Plaintiff resident sought damages from defendant municipality after sewer back up and overflow flooded plaintiff's premises. Plaintiff timely filed a statutorily required notice of claim stating his residence and that the faulty sewer was 'in said vicinity.' Plaintiff contended the defendant had negligently constructed the sewer. Defendant moved for dismissal, alleging plaintiff's notice had failed to explicitly describe the faulty sewer's location and, therefore, did not meet the statutory condition precedent to suit. The Supreme Court, Schenectady County, held that a description enabling municipal authorities to determine, with reasonable diligence, the location of a defective sewer, suffices to meet statutory requirements of notice prior to suit. Plaintiff's description of residence coupled with a statement alleging negligence in the backing up of sewers 'in said vicinity' provided defendant with adequate notice of the plaintiff's claim. Defendant's motion to dismiss was denied absent any claim of misrepresentation. (Earl-Florida) W71-08606

STACK V CITY OF NEW YORK (MUNICIPAL AND PRIVATE LIABILITY FOR SEWAGE OVERFLOW).

134 Misc 105, 234 NYS 486-489 (NY City Ct 1929).

Descriptors: \*New York, \*Flood damage, \*Storm drains, \*Sewers, Storm runoff, Cloudbursts, Overflow, Rain water, Surface runoff, Floods, Drainage system, Drainage system, Drainage practices, Drainage water, Drainage, Damages, Local governments, Real property, Land tenure, Historic flood, Cities, Legal aspects, Judicial decisions, Sewerage.

Plaintiff tenant sought damages from defendant landlord and from defendant city for losses incurred when a sewer overflow flooded her premises. The street abutting plaintiff's residence contained both a sanitary sewer and a rainwater drainpipe. During an extraordinary rainfall, water flowed over the gutter and into plaintiff's re-

sidence. Plaintiff contended defendant landlord knowingly maintained the premises below street level and that defendant city had negligently failed to provide an adequate drainage system. The City Court of New York held that: (1) absent fraud or express warranties, no cause of action against a landlord arises from flood damage to premises below the street grade; and (2) a city in constructing sewers is not bound to provide for extraordinary rainfalls and is not liable when, after such rainfalls, sewers back up and flood private premises. The court noted that plaintiff had failed to establish that sewage came onto the premises or that the drainpipe had been improperly constructed or maintained. Ruling that plaintiff had failed to state a cause of action against the landlord or establish the city's negligence, the court granted verdict for defendants. (Earl-Florida)

SMITH V VILLAGE OF VICTOR (OBSTRUCTING CULVERT AS NUISANCE OR NEGLIGENCE).

134 Misc 888, 236 NYS 566-570 (Sup Ct 1929).

Descriptors: \*New York, \*Culverts, \*Obstruction to flow, \*Adjudication procedure, Flood damage, Highways, Streams, Cities, Maintenance, Flow, Overflow, Construction, Land, Land tenure, Damages, Legal aspects, Judicial decisions, Surface runoff.

Plaintiff sought to recover from defendant village for flood damages to his building. The flooding was caused by a clogged culvert maintained by defendant. Plaintiff alleged that the creation and maintenance of this condition amounted to a nuisance and that his damages were sustained by reason of the nuisance. Defendant moved to dismiss on the ground that defendant's action was based on negligence and that village law prohibited negligence suits against the village unless a written, verified statement of the claim was filed in the village within thirty days after the cause of action accrued. The trial court granted defendant's motion. It was the village's duty to maintain the culvert which became obstructed. However, plaintiff's action was grounded in negligence. Therefore, he was required to comply with the village law regarding filing a statement of claim. At best, plaintiff's action was a nuisance action based on negligence, and, as such, the notice rules applicable to negligence would be applied. (Duss-Florida) W71-08621

CITY OF THOMSON V MCCORKLE (DAMAGES CAUSED BY OVERFLOW OF DRAINAGE SYSTEM).

171 SE 186-187 (Ct App Ga 1933).

Descriptors: \*Georgia, \*Drainage systems, \*Overflow, \*Adjudication procedure, Obstruction to flow, Drains, Drainage, Surface drainage, Surface waters, Rainfall, Cities, Surface runoff, Damages, Legal aspects, Judicial decisions.

Plaintiff property owner sued defendant city to recover damages caused by an overflow of water from defendant's drainage system. Plaintiff in his first petition alleged that defendant's negligent 'maintenance' of the drainage system caused the overflow and plaintiff's damages. Later, plaintiff amended this first petition to allege that defendant had negligently allowed the drainage system to become clogged. In so amending the petition, plaintiff omitted the earlier allegation of negligent maintenance. Defendant at trial attempted to enter the fact of such omission into evidence against plaintiff. The trial court refused to admit such evidence, a verdict was rendered for plaintiff, and defendant appealed on the ground that it was error to reject this evidence and to accept certain other evidence. The Court of Appeals of Georgia reversed. It was error to reject evidence of the stricken allegations. Such evidence would properly tend to show an admission by plaintiff that damage was caused by the inadequate construction of the

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drainage system and not by an obstruction of the drains. However, it was not error to admit, in support of showing the condition at the time of the overflow, evidence showing the condition of the drains after the overflow. (Duss-Florida)

# HILL V CITY OF WINTERSET (DAMAGES FOR CITY'S MAINTENANCE OF NUISANCE). 214 NW 592-593 (Iowa 1927).

Descriptors: \*Iowa, \*Sewage, \*Water pollution, \*Adjudication procedure, Sewers, Ditches, Cities, Septic tanks, Cesspools, Drainage, Construction, Discharge (Water), Watercourses (Legal), Storm drains, Odor, Public health, Judicial decisions, Legal aspects, Damages, Relative rights, Legisla-

Plaintiff landowner brought suit against defendant city to recover damages for maintenance of a nuisance. Defendant had constructed a storm sewer along a public street adjacent to plaintiff's property, and this sewer discharged into an open ditch near plaintiff's premises. Defendant also connected drains from septic tanks and cesspools to the storm sewer, thereby causing the discharge to become offensive and obnoxious. Plaintiff's complaint was based on the offensive nature of this nuisance. Plaintiff received a verdict and defendant appealed. The Supreme Court of Iowa affirmed. The statute under which the action was brought was sufficiently broad to allow introduction of evidence concerning the health hazards of the nuisance, even though plaintiff's claim was based on the obnoxious odors caused by the nuisance. Portions of the evidence regarding sanitary aspects in the utilization of septic tanks were immaterial but were not prejudicial to defendant's case. (Duss-W71-08678

# STOVERN V TOWN OF CALMAR (MEASURE OF WATER POLLUTION DAMAGES TO LESSOR OF RIPARIAN LAND). 216 NW 112-115 (Iowa 1927).

Descriptors: \*Iowa, \*Water pollution, \*Leases, \*Remedies, Pollution abatement, Reasonable use, Riparian rights, Treatment facilities, Water pollution effects, Odor, Municipal wastes, Damages, Sewage, Sewage disposal, Sewage treatment, Rent, Land tenure, Riparian land, Evaluation, Local governments, Cities, Judicial decisions, Legal

Plaintiff landlord sued defendant city to enjoin a nuisance and to recover damages. Plaintiff contended that defendant dumped sewage into a stream bordering plaintiff's property, thereby causing him injury in the amount of reduced rental value to a tenant leasing the land. Defendant contended that an injunction was not appropriate as the city had begun construction of a sewage disposal plant. Defendant also contended that plaintiff could not use reduced rental value of the land as his measure of damages because such damages were for injury to the right of occupancy and comfortable enjoyment of the premises, which belonged only to the tenant. The Supreme Court of lowa affirmed the lower court judgment awarding damages to plaintiff, but remanded the granting of an injunction for further taking of evidence. The court noted that the nuisance had commenced prior to plaintiff's leasing of the property. Where a nuisance is in existence at the time when land is leased by the owner and such nuisance depreciates the rental value of the property, the owner may recover, among other items, damages for the amount of the reduced rental value. (Smiljanich-Florida) W71-08689

STOVERN V TOWN OF CALMAR (ABATE-MENT OF WATER POLLUTION NUISANCE THROUGH CONSTRUCTION OF SEWAGE DISPOSAL SYSTEM). 224 NW 26-27 (Iowa 1929).

Descriptors: \*lowa, \*Pollution abatement, \*Sewage disposal, \*Remedies, Treatment facilities, Water pollution, Riparian rights, Local governments, Cities, Reasonable use, Water pollution treatment, Streams, Sewage treatment, Sewers, Outlets, Industrial wastes, Industrial plants, Judicial decisions, Legal aspects.
Identifiers: \*Injunction (Prohibitory).

Plaintiff landowner sought to enjoin an alleged nuisance caused by defendant city's emptying of sewage into a stream. Plaintiff contended that, although a sewer system had been built by the city subsequent to the commencement of the action, the city continued to pollute the stream. Defendant contended that the nuisance complained of had been abated by the construction of the sewer system. Defendant also contended that, although a private company had continued to pollute the stream through a sewer outlet unknown to the city, such pollution had ceased after the city instructed the company to cut off their sewer. The lower court determined that damages were allowable, but an injunction was not necessary as the pollution had been abated. The Supreme Court of Iowa, in affirming the lower court dismissal of the injunction, noted that subsequent to the cessation of the private sewer outlet, the stream became clear and odorless. Where a city has subsequently constructed a modern and sufficient sewer disposal system, an injunction to abate the water pollution is unnecessary. (Smiljanich-Florida) W71-08692

#### THE FEDERAL NAVIGATION SERVITUDE: IMPEDIMENT TO THE DEVELOPMENT OF THE WATERFRONT,

Eugene J. Morris. St John's Law Review, Vol 45, No 2, p 189-199, 1970. 11 p, 37 ref.

Descriptors: \*Federal government, \*Navigation, \*Non-navigable waters, \*Land tenure, Real property, Social needs, Navigable rivers, Navigable waters, Federal jurisdiction, Administrative decisions, Human population, Ownership of beds, Permits, Relative rights, Riparian land, Riparian rights, Social impact, Compensation, Condemnation value, Political constraints, Construction, Legal aspects, Judicial decisions, Legislation, Rivers and Harbors Act. Identifiers: \*Navigational servitude.

The navigational servitude doctrine, its impact upon waterfront development, and the need for modifying it to meet new priorities are examined in this article. Navigational servitude is defined as the federal right to compel the removal of navigational obstructions without compensation. This right constitutes a cloud on shorefront real property titles, inhibiting real estate development. In congested urban areas with declining port facilities, the doctrine prevents needed housing and industrial shorefront development. Because of their procedural difficulty and infrequency, congressional declarations of non-navigability are depicted as inadequate. Recent expansions of Corps of Engineer authority over construction permits in navigable waters and the effect of state regulation are considered. Proposals authorizing the Secretary of the Army to issue irrevocable or limited permits for shoreline development are discussed. A recent proposal authorizing the Secretary of the Army to study new procedures to allow waiver or modification of navigational servitude is described. The author concludes that continued judicial affirmation of the navigational servitude doctrine does not remove the need for its reassessment in light of changing priorities. (Earl-Florida) W71-08693

## DEPARTMENT OF DEFENSE OFFSHORE MILITARY ACTIVITIES PROGRAM. Department of Defense, Washington, D.C.

Code of Federal Regulations, Title 32, Ch 1, Part

Descriptors: \*Military aspects, \*Continental Shelf, \*Competing uses, \*Beds under water, Subsurface waters, Oceans, Inter-agency cooperation, Priorities, Resource allocation, Coasts, Adoption of practices, Administration, Administrative decisions, Tidal waters, Submerged Lands Act, Continental slope, Continental margin, Leases, Mineral industry, Oil industry, Military reservations, Water policy, Federal government, State jurisdiction, Regulation.

Policies and procedures for offshore public land utilization by the Department of Defense (DOD) are herein promulgated. The provisions herein apply to all DOD components and concern military utilization of the Outer Continental Shelf, including: (1) air space above; (2) surface, subsurface, and seabed areas; and (3) when necessary, state controlled submerged offshore lands. The DOD will make minimum essential use of offshore land and will accommodate non-military interests to the maximum extent feasible. The DOD will endeavor to accommodate determinations of the Department of the Interior or coastal states that the utilization of offshore public lands for mineral production is highly desirable. Where non-military interests can-not be accommodated, the DOD will endeavor to reach agreements excluding such areas from leasing programs. The Assistant Secretary of Defense ing programs. The Assistant Secretary of Defense will: (1) develop and maintain a comprehensive program of military offshore area utilization consistent with policies established herein, (2) review military programs in light of such policies, and (3) negotiate agreements and conduct liason assuring that offshore leasing remains compatible with DOD missions. The military departments will follow procedures established herein to assure mission integrity in light of the policies herein promulgated. W71-08694

## NATURAL RESOURCES: CONSERVATION AND MANAGEMENT. Department of Defense, Washington, D.C.

32 Code of Federal Regulations, part 263, 1970. 5

Descriptors: \*Military reservations, \*Natural resources, \*Conservation, \*Water resources, Administration, Resource allocation, Water conservation, Water policy, Military aspects, Wildlife, Land use, Integrated control measures, Land resources. Recreation, Adoption of practices, Forest management, Public rights, Wildlife conservation, Wildlife management, Ecology, Environment, Project purposes, Federal project policy, Scenery, Resources, Preservation

A Department of Defense (DOD) natural resource program, and policies pertaining thereto, are herein established in compliance with administration policies and 10 U.S.C. Section 2671. As a general policy, the DOD has an obligation to restore, develop, and conserve those natural resources under military control. Such programs need not and shall not be mutually exclusive with military missions. Command personnel will support conservation programs by encouraging professional participation in natural resource disciplines. Outdoor recreation and natural beauty will be recognized as program objectives. DOD components will assure cooperation and coordination with federal, state, and local resource agencies. Defense installations shall be managed in compliance with policies herein set forth. DOD resource policies include the establishment of: (1) conservation programming, budgeting, and financing; (2) soil and water management programs; (3) forest management plans; (4) fish and wildlife management programs; and (5) pollution and

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pesticide control policies. Access to installations by the public and conservation officials shall be granted under conditions herein specified. Installation conservation committees shall be established. The Secretary of Defense's Annual Conservation Award, and the DOD Natural Resources Group are hereby established. (Earl-Florida) W71-08695

## STATE TAX INCENTIVES TO FIGHT POLLU-TION, John W. McNulty.

American Bar Association Journal, Vol 56, p 747-750, 1970. 4 p, 18 ref.

Descriptors: \*Pollution abatement, \*Treatment Descriptors: \*Pollution abatement, \*Treatment facilities, \*Tax rate, \*Legislation, State jurisdiction, Taxes, State governments, Industrial wastes, Water pollution control, Water pollution treatment, Administration, Air pollution, Water pollution, Abatement, Environmental sanitation, Coordination, Financial feasibility, Interstate, Nonstructural alternatives, Capital costs, Economic justification, Government supports, Investment, Legal aspects. Legal aspects.
Identifiers: \*Tax incentives.

Tax incentives for industrial pollution control facilities have not been in the limelight of current environmental conflicts. This article examines the nature and adequacy of state pollution abatement tax incentives. The revenue-producing laws of at least thirty-one states embody such provisions. In most states, pollution control facility certification requires that the facility be 'primarily' for the control, reduction, or elimination of air or water pollution. The author views this requirement as limiting the effectiveness of incentives. Because the Internal Revenue Code's definition of pollution control facilities is tied into state law, this requirement also impairs the availability of federal pollution control write-offs. Incentive categories discussed include: (1) property tax exemption, (2) sales and use tax exemption, (3) income tax credits, and (4) franchise tax exemptions. The failure of several industrial states to adopt incentives is noted, as is the concept of focusing incentives on a particular source of pollution, such as automobiles. The author concludes that: (1) statutory uniformity would increase incentive utilization; (2) a full spectrum of incentives is needed; and (3) a re-examination of the primary purpose doctrine, aimed at establishing realistic certification standards, would be useful. (Earl-Florida) W71-08696

# CONTINENTAL SHELF OIL DISASTERS: CHALLENGE TO INTERNATIONAL POLLU-TION CONTROL, Dennis M. O'Connell.

Cornell Law Review, Vol 55, p 113-128, 1970. 16

Descriptors: \*Water pollution, \*Oil, \*Oil industry, \*Continental Shelf, Marine geology, Oceans, Water pollution effects, Water pollution sources, Water pollution control, Pollutants, Pollution abatement, Legislation, International law, International waters, Legal aspects, Law of the sea, Marine animals, Marine plants, Plankton, Marine fish, Regulation, United States, Foreign waters, Foreign countries.

Identifiers: \*Oil Pollution Act.

The Santa Barbara Channel oil spill and the Torrey Canyon disaster illustrate the need for international action to prevent oceanic oil pollution. In addition to the birds and mammals imperiled by oil spills, such spills may result in a mass destruction of essential organisms in the food chain of marine life. Also, tiny sea plants produce an overwhelming percentage of the world's oxygen, and continuing pollution could create serious oxygen depletion.
Present legislation—the Oil Pollution Acts of 1924
and 1961 and the Clean Waters Restoration Act of 1966--provides insufficient protection from pollution, although the provisions of the Water Quality

Improvement Act are a great improvement. International regulation of oil pollution was attempted in a twenty-nation convention, but the convention applies only to ships of the signatories in their territorial waters. Current international regulation of the Continental Shelf takes a nationalistic approach to pollution, depending on the licensing nation to protect itself from pollution. The Interna-tional Maritime Consultative Organization may provide more effective international regulation of pollution at sea. (Hart-Florida) W71-08697

# FOREWORD TO SYMPOSIUM--LAW AND THE

Edmund S. Muskie

Cornell Law Review, Vol 55, No 5, p 663-665, 1970.3 p.

Descriptors: \*Pollution abatement, \*Environment, \*Water pollution, \*Air pollution, Cities, Public rights, Water pollution sources, Water pollution effects, Water pollution control, Legal aspects, Environmental effects, Industries, Pollutants, Waste treatment, Water pollution treatment, Local governments, Legislation.

As the great industrial cities of the United States grew, the affluent citizens lived in the northern and northwestern portions of the cities, since the prevailing winds from those directions prevented contact with industrial pollution. However, pollution now affects all segments of the society. Tolerating pollution ultimately is more expensive than permitting it; hence many citizens support immediate expenditure of necessary funds to abate pollution. The Water Quality Act and the Air Quality Act are based upon a conviction that public standards for air and water quality should govern uses of air and water resources. Air pollution emissions must be controlled to satisfy air quality stan-dards of the region; water pollution should be controlled through joint treatment plants between mu-nicipalities and industry. Legislation controlling pollution from vehicles and boats, as well as noise pollution, is required. To accomplish pollution abatement, a majority of Americans must adopt new attitudes. Furthermore, extensive planning for environmental protection by both private and public concerns is necessary. The law must provide protection for the environment. (Hart-Florida) W71-08698

# LEGISLATION AND THE ENVIRONMENT: INDIVIDUAL RIGHTS AND GOVERNMENT ACCOUNTABILITY,

Richard L. Ottinger.

Cornell Law Review, Vol 55, No 5, p 666-673, 1970. 8 p, 18 ref.

Descriptors: \*Environment, \*Pollution abatement, \*Federal government, \*Legislation, Public rights, Public health, Environmental effects, Administrative agencies, Administrative decisions, New York, New Jersey, Ecology, Marine animals, Marine plants, Water pollution, Water pollution sources, Water pollution effects, Water pollution control, Pollutants, Sewage, Industrial wastes, Hudson

Identifiers: \*Constitutional amendment.

Man has viewed his environment as a horn of plenty. However, the relationship between man and the environment has reached a critical stage, and public concern with the pollution threat has generated a rash of proposed solutions. Whether the proposals will ultimately abate pollution is questionable, because the real problem is that our institutions are rooted in notions of inexhaustible supply of natural resources. A near-catastrophic example of the failure of our institutions to act is the 'Dead Sea' at the mouth of New York Harbor. The 20 square mile area is totally devoid of marine life because the area lacks sufficient oxygen. This condition is the direct result of sewage and industrial waste being dumped into the sea and the Hudson River. Although federal laws exist to avert ecological catastrophes such as that of New York Harbor, the failure of our agencies to act under the law results from the public's failure to establish a clear social policy for environmental protection. Since statutes may be easily amended, a constitutional amendment is necessary to protect the environ-ment, along with coordination of federal action, judicial review of agency action, and individual concern for the environment. (Hart-Florida) W71-08699

# THE RIGHT TO A DECENT ENVIRONMENT: E-MC2: ENVIRONMENT EQUALS MAN TIMES COURTS REDOUBLING THEIR EF-FORTS,

E. F. Roberts.

Cornell Law Review, Vol 55, p 674-706, 1970. 33 p, 90 ref, 1 append.

Descriptors: \*Environment, \*Legal aspects, \*Pollution abatement, \*Air pollution, Water pollution, Pollutants, Industries, Water pollution control, Water pollution sources, Water pollution effects, Federal government, State governments, Local governments, Cities, Air pollution effects, Public health, Adjudication procedure, Judicial decisions. Identifiers: \*Constitutional rights.

Seeking a means to enforce man's right to a decent environment, this article first analyzes several nuisance decisions which refused to enjoin industrial pollution by applying the balancing of interests theory. The selection of sites for industrial plants was considered a major factor in the decisions. Next, the author postulates that a nuisance may amount to constitutionally prohibited inverse condemnation. He also suggests that local governments condemn development rights on their peripheries, i.e. require municipal consent for development as a part of regional environmental and economic planning integration. Constitutional amendments establishing a right to an environment fit to sustain healthy human life are suggested. The author believes that a similar constitutional right to a decent environment might be found as a part of substantive due process. However, the impact of such a constitutional holding is seen to require that agencies merely give sufficient weight to environmental considerations in their decisions. It is observed that considerations in their decisions. It is observed that a constitutional right to a decent environment would not seriously depart from the grundnorm. Included by appendix is one commissioner's objection to establishment of a nuclear plant in Diablo Canyon, a project approved by the California Public Utility Commission. (Hart-Florida) W71-08700

### THE WILD AND SCENIC RIVERS ACT OF 1968.

A. Dan Tarlock, and Roger Tippy. Cornell Law Review, Vol 55, p 707-739, 1970. 33 p. 135 ref.

Descriptors: \*Wild rivers, \*River systems, \*Scenery, \*Recreation, Condemnation, Eminent domain, Scenic easements, Natural resources, Aesthetics, Conservation, Parks, Roads, Legislation, Federal government, State governments, Legal aspects, Judicial decisions, Administrative agencies, Administrative decisions, Water pollution, Water resources, Water resources development, Banks, Water pollution control.

The Wild and Scenic Rivers Act is a counterweight to federal dam-building programs and limits development of certain rivers and their banks in the name of recreation. The Act is a reaction to the profusion of dams and reservoirs and seeks to preserve some rivers in their natural state. Eight rivers were initially protected; in addition, 27 more rivers were designated for potential inclusion after further study. Protection may be extended to three types of rivers defined in the Act. Either scenic easements or fee simple title in lands contiguous to the rivers may be acquired. The river corridors are to be managed to emphasize aesthetic, scenic, historic, and archeological features. The Act does

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not provide for judicial review of administrative decisions concerning the corridors; however, courts tend to find such decisions reviewable under the Administrative Procedure Act. Also, water resources programs inconsistent with the Act are restricted. The state reservation doctrine is apparently subservient to the Act under the supremacy clause. Although the Act provides only a vague reference to control of pollution, control of the river corridor should prevent pollution from waste discharge. (Hart-Florida)

# AGRICULTURE: THE UNSEEN FOE IN THE WAR ON POLLUTION,

N. William Hines. Cornell Law Review, Vol 55, p 740-760, 1970. 21 p, 111 ref.

Descriptors: \*Agriculture, \*Water pollution, \*Pesticides, \*Fertilizers, Chemicals, Farm wastes, Nitrogen compounds, Phosphorus compounds, Water pollution sources, Water pollution effects, Irrigation practices, Leaching, Confinement pens, Domestic wastes, Soil disposal fields, Waste disposal, Eutrophication, Waste assimilative capacity, Salinity, Saline soils, Salt tolerance, Sedimentation, Sediment Control, Soil conservation.

Agricultural wastes have received practically no attention in recent efforts to prevent and abate water pollution. Control of municipal and industrial wastes may be cancelled by failure to control the four major sources of agricultural pollution: animal wastes, chemicals, sediment, and salt. Pollution from animal wastes results primarily from the use of feed-lots to fatten beef. Feedlot runoff is high in oxygen demand, depleting oxygen supplies in streams; furthermore, the various nutrients in such wastes cause eutrophication. Pollution from feedlots may be controlled by treating drainage and disposing of accumulated solid wastes, although the latter solution has proved difficult. Both agricultural fertilizers and pesticides are major factors in water pollution. Fertilizer, through its chief nutrients--nitrogen and phosphorus--is also respon-sible for eutrophication. Moreover, use of fertilizer strictly regulated, present regulations are not directed towards water pollution. The potential harm of pesticides has not been thoroughly evaluated. Quantitat ively, sediment is the most serious agricultural water pollutant; inefficiency of soil conservation districts is primarily responsible. Excessive salinity affects agricultural productivity. Irrigation increases the problem, and an adequate solution has been evasive. (Hart-Florida) W71-08702

# LEGAL PLANNING FOR THE TRANSFER OF WATER BETWEEN RIVER BASINS: A PROPOSAL FOR THE ESTABLISHMENT OF THE INTERBASIN TRANSFER COMMISSION, Michael D. White, and Charles P. Eddy. Cornell Law Review, Vol 55, p 809-845, 1970. 37

Cornell Law Review, Vol 55, p 809-845, 1970. 37 p, 236 ref.

Descriptors: \*Inter-basin transfers, \*Water resources development, \*Water supply, \*Water transfer, Water rights, Appropriation, Natural flow doctrine, Preferences (Water rights), Prior appropriation, Riparian rights, Competing uses, Relative rights, Reasonable use, Legislation, Eminent domain, Condemnation, Compensation, Federal government, State governments, Navigation, Interstate commissions, River basin commissions, Interstate rivers, Water policy, Equitable apportionment.

Although water scarcity in particular areas might be alleviated by interbasin transfers, this solution is prevented by the absence of cooperative water resources management. Traditional water law protects stream water rights in the source basin either by the prior appropriation or the riparian rights doctrine. Rights in underground water are also protected by various doctrines. In addition, water

rights in the area of origin may be protected by state statutes, federal legislation, or anti-export statutes. Acquisition of vested water rights in the area of origin is a major obstacle to interbasin transfers. Transfer planners must decide: (1) which uses in the transferee basin should be favored at the expense of which uses in the transferor basin, (2) whether water rights may be obtained by purchase or condemnation, and (3) the value of water rights so obtained. Additionally, the federal government may take water rights without exercising the eminent domain power under the proprietary power or the navigation power. States may also take water rights without compensation under the navigation servitude. However, an effective or-ganization for arranging interbasin transfers is lacking; therefore, a new federal agency, the Interbasin Transfer Planning Commission, is required to coordinate transfers with river basin commission. (Hart-Florida) W71-08703

# ENVIRONMENTAL CONTROL: HIGHER STATE STANDARDS AND THE QUESTION OF PREEMPTION, Samuel C. V. D. Kilbourn.

Samuel C. V. D. Kilbourn. Cornell Law Review, Vol 55, p 846-860, 1970. 15 p, 70 ref.

Descriptors: \*Legal aspects, \*Pollution abatement, \*Federal governments, \*State governments, Judicial decisions, Legislation, Water pollution, Air pollution, Water pollution control, Federal jurisdiction, State jurisdiction. Identifiers: Constitutionality.

recently enacted Minnesota statute imposes stricter radiation controls than do Atomic Energy Commission regulations; the statute has been challenged on the basis of the pre-emption doctrine. This conflict may be a prototype of future controversies in the environmental control area. The federal-state conflict arises from the state power to protect the public health and welfare vis-a-vis federal powers under the general welfare clause. Since the Constitution explicitly pre-empts state action in only a few areas, federal pre-emption is generally implied from the breadth of federal regulation and the supremacy clause. However, whether preemption has occurred is a matter for the courts. A determination of implied supersedure of state action chiefly amounts to judicial balancing of competing federal and state interests. However, a presumption in favor of concurrent state power assists the courts in upholding state action. Moreover, state action involving potentially violent labor picketing has been upheld despite the pervasiveness of the Taft-Hartley Act. Analogously, state environmental protection laws may be sustained despite federal nationwide pollution control efforts. (Hart-Florida) W71-08704

#### WATER POLLUTION CONTROL IN VER-MONT: A SYSTEM OF EFFLUENT CHARGES, Hobart Birmingham.

Journal of Law Reform, Vol 4, No 1, p 135-147, 1970. 13 p, 73 ref.

Descriptors: \*Vermont, \*Water pollution control, \*Water quality control, \*Water permits, Legislation, Effluents, Economic justification, State governments, Pollution abatement, Water pollution, Administrative decisions, Administrative agencies, Legal aspects, Permits, Water quality, Waste disposal, Wastes, Waste water (Pollution), Judicial decisions, Non-structural alternatives, Environmental sanitation, Water policy, Supervisory control (Power), Adoption of practices.

identifiers: \*Effluent charges.

Examined in this note are the strengths and weaknesses of Vermont's 1970 water pollution control law. Basically, the Act directly regulates water quality standards through the issuance of discharge permits. However, it includes provision for temporary, non-complying permits coupled with effluent charges based upon damage to downstream users. Permanent permits will be granted only upon a finding that the quality of receiving water will not be diminished below established standards. By incorporating and upgrading existing quality standards, the Act could result in virtually pollution free waters. In the author's view the Act's effectiveness will depend upon: (1) administrative flexibility in adjusting discharge levels, (2) judicial interpretations of 'receiving waters', and (3) utilization of discretionary and judicial remedies. Possible adverse consequences of balancing economic and water quality standards are considered. The Act's effluent charge provision is examined with respect to its: (1) use in balancing interests, (2) underlying economic rationale, and (3) utility as a pollution abatement incentive. The author concludes that the Act falls short of model status in that it misconstrues the goal of effluent charges and attempts to combine two distinct water management systems. (Earl-Florida) W71-08705

# SAVING BYRON'S SEA: FEDERAL AND STATE REGULATION OF OIL POLLUTION FROM OCEAN PETROLEUM PRODUCTION,

William John Rathje. Hastings Law Journal, Vol 22, No 3, p 485-522, 1971. 38 p, 178 ref.

Descriptors: \*Oil wells, \*Oily water, \*Water pollution sources, \*Oceans, Drilling, Offshore platforms, Federal government, State governments, California, Legislation, Submerged Lands Act, Administrative agencies, Inspection, Control, Remedies, Continental Shelf, Natural resources, Water pollution, Water pollution control, Pollutants, Damages, Resource development, Regulation, Public rights, Marine geology.

Discussing the problem of oil pollution from offshore petroleum drilling, the main concerns of this article are the existing legal controls designed to minimize the incidence of oil pollution resulting from the development of marine petroleum resources. The author considers the situation as it exists in California and identifies both the federal and state law designed to prevent oil spill incidents. He also points out inadequacies in governmental controls and makes some recommendations for new legislative action. Attention is also given to the rights of private individuals damaged by oil spills. The Department of the Interior and two of its subagencies exercise jurisdiction over ocean petroleum development. Regulationg governing oil drilling inform operators of their responsibility to avoid pollution and set minimum technical standards for operation of wells. The principal deficiencies in the Federal program result from inadequate inspection of offshore drilling operations and the absence of sanctions. California is more rigorous in its control, as its provisions concerning responsibilities and technical standards are buttressed by sanctions and systematic inspections. The author also considers the geological problems involved in offshore drilling and the need for increased governmental regulation in this area to improve the safeguards against pollution. (Duss-Florida) W71-08706

# THE LAW OF WATER DISTRIBUTION IN IOWA AND SOUTH DAKOTA: A COMPARISON OF THE RIPARIAN AND APPROPRIATIVE SYSTEMS,

Max A. Gors.
Drake Law Review, Vol 20, No 2, p 256-287, 1971.
32 p, 418 ref.

Descriptors: \*Iowa, \*South Dakota, \*Water allocation (Policy), \*Appraisals, Water policy, Water permits, Legislation, Judicial decisions, Appropriation, Water utilization, Legal aspects, Regulation, Reasonable use, Artificial use, Competing uses, Natural flow doctrine, Prior appropriation, Relative rights, Riparian rights, Water rights, Comparative benefits, Preferences (Water rights), Priorities, Riparian waters, Riparian land, Administration.

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The legal theories underlying surface and ground-water distribution in Iowa and South Dakota are analyzed and contrasted in this article. The development of water law is determined by climate, geography, topography, and use. The history, development, principles, and nature of prior appropriation and riparian doctrine in semi-arid South Dakota, and of riparianism in more humid Iowa, are examined. Riparian principles relating to: (1) land ownership; (2) natural watercourses; and (3) the doctrines of natural flow, reasonable use, artificial use, and non-riparian use are analyzed by the author. The nature and history of appropriative interests in South Dakota are examined. A comparison of diffused surface water theory in both states is made. Differing rules control underground streams and percolating groundwater. The com-mon law and prior appropriation rules governing percolating groundwater are analyzed. The sources of authority for water distribution administration in both states are contrasted in terms of: (1) policy, (2) non-regulated uses, (3) regulations, and (4) constitutional questions. The procedures, duration, privileges and rights, and nature of the interest granted by each state's water permit system are analyzed. (Earl-Florida) W71-08707

### DEVELOPMENT RECREATIONAL LICENSED PROJECTS. Federal Power Commission, Washington, D.C.

Federal Register, Vol 35, No 76, p 6315, Apr 1970.

Descriptors: \*Federal Power Act, \*Safety, \*Recreation facilities, \*Federal project policy, Administrative agencies, Recreation, Safety factors, Adoption of practices, Administration, Decision making, Legal aspects, Legislation, Federal government, Project planning, Regulation, Administrative decisions.

Identifiers: Administrative regulations.

Federal Power Commission policy concerning safety measures at outdoor recreational projects licensed under the Federal Power Act is herein clarified and amended. Federal Power Commission Order No. 375 was intended to provide examples of safety measures for the guidance of licensees, recreationists, and the public. It was not intended to require the installation of specific safety facili-ties, nor to establish legal standards. To make it clear that no legal requirement was intended, and pursuant to the Federal Power Act, paragraph (f) (2) of Section 2.7 of the Commission's general policy and interpretations is therefore deleted. (Earl-Florida) W71-08708

# OIL POLLUTION REGULATIONS.

Coast Guard, Washington, D.C.

33 Code of Federal Regulations, part 151, 1970. 4

Descriptors: \*Oil wastes, \*Water pollution control, \*Ships, \*Coast Guard regulations, Adoption of practices, Water pollution sources, Boats, Oily water, Storage tanks, Water quality control, Supervisory control (Power), Pollutants, Pollution abatement, Regulation, Administration, Administrative decisions, Sea water, Legal aspects, Legislation,

Identifiers: Oil Pollution Act of 1961.

The administrative regulations set forth herein implement the Oil Pollution Act of 1961, which in turn implements the International Convention for the Prevention of Pollution of the Seas by Oil. Subject to certain exceptions, the regulations are ap-plicable to any seagoing vessel of American registry or nationality. Foreign vessels to which the Convention applies may be boarded and examined in U.S. territorial waters. Employees of the Corps of Engineers, the Bureau of Customs, and the Coast Guard are designated to board vessels, make inspections, require the production of records, and

arrest violators. All sea areas within 50 miles of land, and the eleven zones herein described, are prohibited zones. An oil record book shall be maintained and descriptive entries made after the following operations: (1) ballasting or discharge of tanker ballast, (2) cargo tank cleaning, (3) slop tank settling or water discharge, (4) disposal of oily residues, (5) ballasting or cleaning bunker-fuel tanks, and (6) exceptional or accidental oil discharges. Upon the completion of foreign voyages, such book shall be delivered to the Coast Guard. The record book shall remain on board during and after non-foreign voyages. Penalties for violations of these regulations are contained in the Oil Pollution Act of 1961. (Earl-Florida) W71-08709

### MAINTENANCE OF WATER LEVELS AT TWO RESERVOIR PROJECTS.

33 Code of Federal Regulations, Title 33, Ch 2, secs 208.65, 208.66, 1970. 4 p.

Descriptors: \*Alabama, \*Reservoir operation, \*Flood control, \*Water levels, Reservoirs, Dams, Reservoir storage, Water storage, Discharge (Water), Hydroelectric plants, Hydroelectric power, Regulation, Administrative agencies, Administration, Outlets, Rivers, Projects, Federal

In the interest of flood control, the Alabama Power Company, as owner and operator of two dam and Company, as owner and operate of two data the reservoir projects, shall operate them in accordance with regulations promulgated herein by the United States Army Corps of Engineers. The water levels at both projects are to be maintained according to their respective Storage Delineation Curves (top-of-power-pool curves). Specific provisions prescribe the circumstances, ways, and quantities in which water may be released and discharged. Releases made in accordance with these regulations are subject to the condition that they shall not be made in a manner inconsistent with protecting the dams and reservoirs from major damage. The power company shall furnish to the District Engineer such hydrological data as may be necessary to monitor the flood control operations of the projects. These regulations are subject to modification by the District Engineer if conditions make such modification desirable. (Duss-Florida) W71-08710

# POLLUTION OF THE GREAT LAKES AND

SOLID WASTE DISPOSAL AT SEA.
116 Cong Rec H 3068 (daily ed), 4 US Code Cong
and Admin News p 1095-1096 (1970). 2 p.

Descriptors: \*Great Lakes, \*Dredging, Waste dumps, \*Oceans, Water quality control, Water pollution control, Federal government, Pollution abatement, Legislation, Legal aspects, Spoil banks, Water pollution sources, Environmental effects, Disposal, Environmental engineering, Pollutants, Municipal wastes, Garbage dumps, Investigations, Administration, Adoption of practices, Leadership, State governments.

State governments.
Identifiers: Presidential messages.

This Presidential message to Congress deals with: (1) administration proposals to restrict polluted dredge-spoil dumping in the Great Lakes; and (2) the initiation of a study examining solid waste disposal in the oceans. The administration's bill, aimed at restoring the Great Lakes, would: (1) discontinue polluted dredge-spoil disposal by the Corps of Engineers and private interests, (2) require that such disposals be made in containment areas, (3) require states and other non-federal sources to provide one-half the cost of such containment areas, and (4) suspend Corps of Engineer dredging after one year if local interests fail to make reasonable progress in establishing containment areas. Periodic program progress reports would be made by the Secretary of the Army. The Council on Environmental Quality has been directed, in conjunction with other federal, state

and local agencies, to undertake a comprehensive study of ocean dumping. This study will examine the following areas: (1) the effects of ocean dumping on the environment, (2) the adequacy of existing legislation, (3) amounts and areas of toxic dumping, (4) the availability of land disposal sites, (5) alternative disposal methods, (6) suggested innovative ideas, and (7) institutional problems.

# LIABILITY FOR OIL POLLUTION CLEANUP--NON-SELF-PROPELLED BARGES EXEMPTED UNDER CERTAIN CIRCUMSTANCES.

Federal Register, Vol 36, No 43, p 4293-4294, Mar 1971.2 p.

Descriptors: \*Oil, \*Water pollution sources, \*Regulation, \*Administrative agencies, Water pol-lution, Navigable waters, Federal government, Legislation, Navigation, Transportation, Harbors, Bodies of water, Fuels, Administrative decisions, Water pollution control.

Setting forth the Federal Maritime Commission's regulation covering financial responsibility for oil pollution cleanup, this report by the Commission discusses the exemption from liability under the financial responsibility section. Section 11 (p) (1) of the Federal Water Pollution Control Act as amended requires every vessel exceeding a certain size to maintain evidence of financial responsibility in case of discharge of oil into waters of the United States. However, the Rivers and Harbors Act of 1970 (Public Law 91-611) excludes from financial responsibility non-self-propelled barges carrying no oil as cargo or fuel. In order to conform to this new law the Commission amended its regulations, including new sections defining 'cargo' and 'fuel'. Several shipping organizations and companies submitted comments to the Commission in favor of a less restrictive definition of fuel than the one proposed by the Commission so as to permit the carrying of small quantities of oil aboard non-selfpropelled barges used to operate machinery on these barges. The Commission rejected the contentions of these parties. For purposes of their regula-tions 'fuel' means any oil used or capable of being used to generate heat or power by burning. (Duss-Florida) W71-08712

### ENVIRONMENTAL INFORMATION.

Environmental Science Services Administration, Washington, D.C.

15 Code of Federal Regulations, part 907, 1970. 1

Descriptors: \*Weather data, \*Weather forecasting, \*Publications, \*Meteorological data, Weather, Technical writing, Climatic data, Storms, Snow, Rain, Data collections, Forecasting, Charts, Maps, Libraries, Information retrieval, Documentation, Statistics, Environment, Flow profiles, Ocean currently of the Charts, Maps, Charts, Market Parket rents, Tides, Seismic waves, Seismology, Weather patterns. Identifiers: \*Environ Science Serv Admin.

The types and availability of information disseminated by the Environmental Science Services Administration (ESSA) are herein described. ESSA gathers, processes, and issues information on : (1) weather conditions, (2) river water height, (3) coastal tides and currents, (4) ocean current movement, (5) ocean basin shapes and structures, (6) seismic activity, (7) precise earth shape and size, and (8) space and upper atmospheric conditions. Hurricane, tornado, flood, and seismic sea-wave warnings are also issued. ESSA information falls into three categories: (1) current information and warnings on dynamic environmental conditions; historical summaries, graphic (2) charts, historical summaries, graphic recordings, and other longer term information; and (3) technical earth science research. Current information is disseminated either directly, through

### Group 6E—Water Law and Institutions

local offices, or through relaying mediums. A Daily Weather Map and a Weekly Weather and Crop Bulletin may be ordered through the Superintendent of Documents, Washington, D.C. Longer term information may be purchased through local sales agents or through ESSA. Price lists and catalogs are available. Information concerning scientific and technical research publications may be obtained. (Earl-Florida) W71-08713

COUNTY DITCH NO. 13, JACKSON COUNTY V BOARD OF COUNTY COMMISSIONERS (BOARD'S DENIAL OF PETITION TO IMPROVE DITCH FOUND REASONABLE).

182 NW2d 715-717 (Minn 1971).

Descriptors: \*Minnesota, \*Drainage, \*Ditches, \*Controlled drainage, Land, Land tenure, Construction, Culverts, Surface waters, Rainfall, Damages, Surface drainage, Surface runoff, Legislation, Judicial decisions, Legal aspects.

Plaintiff landowners petitioned to have a drainage ditch benefiting their land improved because it was of insufficient capacity to handle additional drainage. The county board of commissioners dismissed the petition, stating that the proposed improvement was not practicable and would not benefit the public. One petitioner appealed to the district court, which affirmed the county board's ruling. The Supreme Court of Minnesota affirmed the district court. In matters involving construction and improvement of drainage facilities a substantial amount of discretion lies with the governmental body first having jurisdiction over the matter. Their decisions will not be overturned unless there is no legal basis for them. The evidence here supported the district court's determination that the county board's denial of the petition was not arbitrary, unlawful, nor unsupported by the evidence. (Duss-Florida)

HOLBROOK V APPLEBERRY (RIGHTS AND RESPONSIBILITIES OF ADJACENT LAN-DOWNERS IN COMMON DRAINAGE DITCH) 463 SW2d 100-102 (Ark 1971),

Descriptors: \*Arkansas, \*Ditches, \*Easements, \*Drainage, Judicial decisions, Legal aspects, Boundaries (Property), Farms, Overflow, Drainage water, Surface runoff, Land tenure, Land, Relative rights.

A determination of the respective rights and responsibilities of appellee and appellant landowners in a common drainage ditch was sought. The ditch ran down their common boundary, across appellant's tract, and into a bayou. The ditch was constructed under an oral agreement between appellee and appellant's now deceased husband; both contributed to the construction costs. The chancellor held that: (1) the ditch was mutual and common, (2) each party possessed a drainage easement across the lands of the other, (3) neither party could obstruct the drain without consent of the other, (4) the parties could have the ditch restored to its former depth and width, and (5) each party should maintain the ditch on his own land. Appellant contended that these findings were unsupported by the evidence and that appellee had purchased additional land draining into the ditch. The Arkansas Supreme Court upheld the chancellor's finding and rejected appellant's assertion that appellee was surcharging the easement. The court und that the evidence failed to demonstrate which party had caused the ditch to become overburdened with water. (Hart-Florida) W71-08715

CITY OF GLADSTONE V HAMILTON (DAMAGES FOR CONDEMNATION WHERE NO SPECIAL BENEFIT INURES TO THE LANDOWNER)

463 SW2d 622-626 (Ct App Ky 1971).

Descriptors: \*Missouri, \*Condemnation, \*Adjudication procedure, \*Sewers, Eminent domain, Damages, Compensation, Cities, Easements, Right-of-way, Legal aspects, Judicial decisions, Urbanization.

Plaintiff municipality brought action against defendant landowner to condemn a sewer easement. Plaintiff asserted that defendant was not damaged by the taking. After instructing the jury on damages, the trial court gave the following instruction on plaintiff's motion: 'your verdict must be for plaintiff . . if you do not believe that the defendants have been damaged.' The jury found no damages. However, the Kansas City Court of Appeals stated that any taking implied at least nominal damages, and a verdict of no damages was authorized only when plaintiff had shown special benefits inuring to defendant which exceeded his damages. Since plaintiff had not provided evidence of special benefits, the court held that the jury instruction for plaintiff was prejudicial error and was not consistent with the rules of procedure. The action was remanded for a new trial. (Hart-Florida) W71-08716

# CHIPLEY V BEELER (LIABILITY FOR ALTERING FLOW OF SURFACE WATER). 178 SE2d 767-769 (Ct App Ga 1970).

Descriptors: \*Georgia, \*Surface runoff, \*Ridnce (Legal aspects), \*Repulsion (Legal aspects), Drainage water, Surface waters, Surface drainage, Culverts, Drainage effects, Drainage practices, Drainage, Damages, Local governments, Relative rights, Paving, Construction, Alteration of flow, Water pollution, Ponds, Easements, Real property, Land tenure, Legal aspects, Judicial decisions, Adjudication procedure.

Plaintiff upper landowner sought to enjoin defendant down-hill property owners from obstructing the natural flow of surface water. The construction of plaintiff's driveway by the county had caused polluted surface water to accumulate on defendants' property. A subsequent extension of plaintiff's drainage pipe caused such water to flow into defendants' pond. Defendants sealed this pipe causing water to back up on plaintiff's property. Plaintiff claimed an interference with his drainage easement. Defendants, counterclaiming, sought an injunction and both punitive and special damages for plaintiff's diversion of polluted waters. The trial court entered injunctions against both parties. The plaintiff appealed a jury verdict on defendants' counterclaim. The Georgia court of appeals held that one who accepts a county's construction of a driveway altering the natural flow of surface water is liable for special and punitive damages arising from such alteration of flow. Plaintiff by accepting the driveway ratified the tortious act committed. The fact that defendants' pond had been made useless for swimming and fishing supported the verdict. (Earl-Florida) W71-08717

TEXAS GAS TRANSMISSION CORP V KIN-SLOW (VALUATION OF SPRING IMPAIR-MENT).

461 SW2d 69-72 (Ky 1970).

Descriptors: \*Kentucky, \*Damages, \*Pipelines, \*Springs, Cold springs, Groundwater, Percolating water, Spring waters, Confined water, Seepage, Fresh water, Real property, Land tenure, Right of way, Subsurface waters, Subsurface flow, Permeability, Contracts, Claims (Contracts), Legal aspects, Judicial decisions, Adjudication procedure, Groundwater movement.

Plaintiff farm owners sought damages from defendant pipeline owner for impairment of a spring. Defendant's installation of a gas pipeline has permanently dried up a spring on one of plaintiffs' two adjoining tracts of land. Plaintiffs contended that they granted the pipeline right-of-way in return for an oral agreement to compensate them for any spring impairment. Defendant appealed as exces-

sive, a judgment in favor of the plaintiffs. The Kentucky Court of Appeals held a determination of damages to a multi-tract farm, from the impairment of a spring, must be based upon: (1) a before and after market valuation of all tracts as a single economic unit; (2) the diminution in market value, absent evidence the impairment can be cured; and (3) testimony restricted to the highest and best potential uses of the farm. Plaintiffs' parole evidence regarding defendant's compensation agreement was held admissible as consideration for plaintiffs' agreement. Determining plaintiffs' damages had not been properly valued, the court reversed the judgment. (Earl-Florida)

HICKS V SEABOARD COASTLINE RR (AFFECT OF RIVER'S NAVIGABILITY UPON RAILROAD'S LIABILITY FOR INJURING FISHERMAN).

179 SE2d 532-535 (Ct App Ga 1970).

Descriptors: \*Georgia, \*Railroads, \*Navigable rivers, \*Lumber, Pulp and paper industry, Bridges, Non-navigable waters, Rivers, Fishing, Judicial decisions, Legal aspects, Adjudication procedure, Remedies.

Plaintiff fisherman sued defendant railroad for damages. While fishing under a trestle belonging to defendant, plaintiff was injured by a log falling from one of defendant's trains. Defendant contended that the river in which plaintiff was fishing was navigable and therefore not railroad property. Prior judicial decisions required railroads to take precautions to prevent injury to persons in the vicinity of a railroad right-of-way where their presence was known or could be reasonably anticipated. Hence the Georgia Court of Appeals held that the navigability of the river was immaterial to a determination of defendant's negligence and liability and that the trial court had not erred by refusing to admit evidence of navigability. (Hart-Florida) W71-08719

STEPPED-UP WAR ON POLLUTION. US News and World Report, p 20-21, Jan 11, 1971. 2 p.

Descriptors: \*Water pollution, \*Air pollution, \*Federal government, \*Industries, State governments, Water pollution control, Pollution abatement, Administrative agencies, Administrative decisions, Administration, Regulation, Legislation, Judicial decisions, Legal aspects, Effluents, Industrial wastes, Discharge (Water), Waste water (Pollution), Taxes, Clean Air Act, Environment, Environmental effects.

Identifiers: \*National Air Quality Standards Act, \*Refuse Act, \*Environmental Protection Agency.

Concern over America's environment is changing from talk to action. The federal government is promulgating more stringent standards to prevent air and water pollution. The Environmental Protection Agency is requiring 40,000 industrial plants to furnish information concerning effluent discharge into waters. In addition, the Treasury Department has announced tax incentive depreciation schedules for pollution control equipment. Stiff fines are being levied for violation of pollution control standards. The National Air Quality Standards Act and the Environmental Protection Agency are being used to clean up the air. States, too, have enacted environmental protection laws; Illinois, Pennsylvania, Michigan, Florida, and California are examples. Additionally, industry is increasing actiont to prevent pollution. However, many industries are concerned that the new laws will not be enforced even-handedly and are being constantly changed and tightened; hence, spending for pollution abatement by industry is being delayed. Meanwhile, in the courts, lawsuits are being filed and injunctions sought. A chart in this article indicates that federal pollution control expenditures have increased from \$768 million in 1969, to an estimated \$1,386 million in 1971. (Hart-Florida) W71-08720

### Water Law and Institutions—Group 6E

MARINE OIL POLLUTION AND THE WATER QUALITY IMPROVEMENT ACT OF 1970, New York Univ., N.Y. School of Law.

Nicholas J. Healey, and Gordon W. Paulson. Journal of Maritime Law and Commerce, Vol 1, No 4 (July 1970), p 537-572.

Descriptors: \*Oil wastes, \*Pollution abatement, \*Water quality, \*Legislation, Legal aspects, Water

Identifiers: Liability, Water Quality Improvement Act of 1970.

The oil pollution provisions of the Water Quality Improvement Act of 1970 and the antecedents of the act, including: the Oil Pollution Act of 1924 as amended in 1966; the International convention for the Prevention of Pollution of the Sea by Oil; the 1961 Oil Pollution Act; and the Federal Water Pollution Control Act are discussed. The principle features of the Act which relate to oil pollution are considered such as the civil liability of third parties for acts or omissions; reimbursement of expenses for owners or operators of pollution causing vessels who clean up discharges; administration; financial responsibility requirements for vessels using United States ports; and the presidential regulations to control hazardous substances and vessel sewage. The act is compared to the convention on Civil Liability for Oil Pollution Damage. The most fundamental difference between the two is that the convention provides not only for government claims for clean up, but also for claims for other damages sustained by both public and private interests. Also there is a difference in the maximum liability which can be imposed under each. The provisions of each are compared relating to financial responsibility.
(Ensign-PAI)

## CONTIGUOUS ZONES FOR POLLUTION CON-TROL: AN APPRAISAL UNDER INTERNATIONAL LAW,

Miami Univ., Fla. Norman A. Wulf.

Sea Grant Technical Bulletin, No 13, Mar 1971. 189 p. NSF Sea Grant - GH 100.

Descriptors: \*Oceans, \*Oil wastes, \*Water pollution control, \*International law, \*Water law, \*Legislation, \*United States, Legal aspects,

Governments.
Identifiers: \*Pollution prevention contiguous zones, Canada.

An appraisal is made of the lawfulness of contiguous zones for pollution control as has been established by the U.S. and Canada. The interaction between transportation interests and coastal interests, particularly relating to the oil industry and oil pollution, is examined. The legislative background and the competence claimed by the U.S. claim to a 12 mile contiguous zone for pollution control, and by the Canadian claim to a 100 mile contiguous zone for pollution control in Arctic waters, are analyzed. Decision-makers who could work with conflicting interests are various intergovernmental organizations such as the IMCO, international conferences and courts or tribunals, and officials of nation-state, state-state, and stateindividual. Goals for specific competence in contiguous zones are clarified, then the specific competences, claims and trends in decision are evaluated. Steps to reduce the oil pollution threat to coastal interests seem justified, but no state should be allowed to unilaterally exercise competence in areas where international interests are paramount. (McEntyre-PAI) W71-08754

#### OIL POLLUTION CONVENTION AMENDED,

Shell International Marine Ltd., London (En-

gland). For primary bibliographic entry see Field 05G.

W71-08756

CRITICAL VIEW OF 1969 AMENDMENTS, Nordic Union on Oil Pollution, Stockholm (Sweden).

For primary bibliographic entry see Field 05G. W71-08757

#### THE COASTAL RESOURCES MANAGEMENT PROGRAM OF TEXAS: A SUMMARY.

Coastal Resources Management Program, Interagency Natural Resources Council, A Report to the 62nd Texas Legislature, Dec 1970. 15 p.

Descriptors: \*Texas, \*Inter-agency cooperation, \*Coasts, \*Water resources development, \*Water management, Legislation, Federal government, State government.

Identifiers: \*Interagency National Resources Council, \*Texas Coastal Resources Management

Program.

This interim report on the Coastal Resources Management Program of Texas is presented by the Interagency National Resources Council, a consortium of State agencies. Fifteen major problems involving the national resources of the Coastal Zone of Texas are examined. The Coastal Resources Management Program has approached the Coastal Zone environment as a balanced system composed of 21 major components needing both individual and interrelated studies. Governmental roles in environmental management must be well defined to provide a clear understanding of Federal, State and local responsibilities and authority. Over 500 environmental bills pending congressional action in Washington would affect the natural resources of the Texas Coastal zone. The Senate and House bills, 'National Estuarine and Coastal Zone Management Act of 1970,' and a Senate bill, the Management Act of 1970, and a senate bill, the 'National Land Use Policy Act,' are described. The conclusions of this report illucidate the important need for a role of the Texas Coastal Resources Management Program. Specific actions are recommended to the Texas 62 Legislature, including cooperation with the Interagency Natural Resources Council to accomplish nine itemized tasks pertaining to the natural resources of the Coastal Zone. A two-year work plan would include eleven areas of needed investigations. (McEntyre-PAI) W71-08759

## DONALDSON V CITY OF MARSHALL (LIA-BILITY OF CITY FOR IMPROPER MAINTENANCE OF TILE DRAIN).

247 Mich 357, 225 NW 529-530 (1929).

Descriptors: \*Michigan, \*Tile drains, \*Floods, Descriptors: "Michigan, "The drains, "Floods, \*Obstruction to flow, Repulsion (Legal aspects), Surface drainage, Drainage, Drains, Surface runoff, Submergence, Sewers, Natural flow doctrine, Alteration of flow, Relative rights, Drainage effects, Drainage systems, Natural flow, Drainage water, Local governments, Cities, Judicial decisions, Legal aspects.

Plaintiff landowner sued defendant city to recover damages for the accumulation of water on plaintiff's land. The damage was allegedly caused by the faulty construction of a tile drain and failure to keep the drain free from obstruction to the natural flow of water. Plaintiff contended that the city failed to use reasonable care in the construction and maintenance of the drain. Defendant contended that it was under no obligation to drain plaintiff's land and denied negligence in the construction and maintenance of the drain. The Supreme Court of Michigan, in affirming a lower court judgment for plaintiff, noted that the city had the authority to establish a system of drainage. When a city establishes a drain, however, becomes its duty to maintain the drain in such a way as to carry off the natural flow of the water. The city was therefore liable for any damages caused by water accumulating as a result of its failure to properly clean the drain. (Smiljanich-Florida)

W71-08764

MARINE POLLUTION AND FISHERIES, For primary bibliographic entry see Field 05G. W71-08765

# AFTERMATH OF CALIFORNIA SPILL LIN-

For primary bibliographic entry see Field 05G.

# HUGHES V VILLAGE OF NASHWAUK (LIABILITY OF CITY FOR NUISANCE CAUSED BY OVERFLOW OF SEWER). 225 NW 898-901 (Minn 1929).

Descriptors: \*Minnesota, \*Sewers, \*Overflow, \*Remedies, Sewage disposal, Waste water (Pollution), Surface drainage, Surface runoff, Drainage water, Sewage, Water pollution, Municipal wastes, Land tenure, Relative rights, Damages, Local governments, Cities, Judicial decisions, Legal aspects, Adjudication procedure. Identifiers: \*Nuisance.

Plaintiff landowner sued defendant city to enjoin a nuisance and to recover for damages caused by the nuisance. Plaintiff contended that defendant had abandoned a surface drainage system and caused the surface waters to be discharged into the city sewer system. Plaintiff also contended that the sewer system was inadequate for this purpose and had overflowed, discharging sewage into plaintiff's basement. Defendant contended that plaintiff had failed, as required by law, to give the city notice prior to bringing action. In affirming a trial court order that plaintiff had stated a cause of action, the Supreme Court of Minnesota noted that an owner or lawful occupant of property is entitled to maintain an action for an invasion of his property rights caused by a municipality casting sewage on the property and thereby creating nuisance. Plaintiff had based his claim upon nuisance--not upon negligence. An equitable action for injuction of a nuisance and damages does not require prior notice to the city. (Smiljanich-Florida) W71-08769

# NATIONAL POLICY FOR COASTAL MANAGE-

Washington Univ., Seattle. Edward Wenk. Vital Speeches, Vol. 37, No. 6, p 177-181, January

Descriptors: \*Coasts, \*Federal government, \*Civil engineering, \*Water policy, Water management, State governments. Identifiers: NOAA.

Issues concerning the coastal zone, and policies urgently needed for its management, are examined. The primary issue is how to provide for the many diverse, conflicting coastal demands and still provide the greatest long-term social and economic benefits. Basic needs include a national policy to balance protection and development, comprehen-sive management plan prepared at the state level for all coastal land and water use, a state regulatory authority, public notices and hearings for management plan development and modification, ecological and policy research, and multi-jurisdictional cooperation. The formulation, operation and potential of the new U.S. National Oceanic and Atmospheric Administration (NOAA) are described. Three major issues the nation faces are 1) establishment of federal policy on coastal affairs, and funds for implementation; 2) development of state management programs; and 3) coastal research and technology development free of politics. The civil engineer should apply himself to the preservation of the coastal zone by public expression and vision, by participating in institutional frameworks for action, by seeking knowledge for better decisions, and by breaking down narrow technical specialization to better unite scientists and the public. (McEntyre-PAI)

## Group 6E—Water Law and Institutions

W71-08770

TOWN OF LUMBER CITY V PHILLIPS (DUTY OF CITY TO CLEAN UP OPEN SEWAGE DITCH).

164 SE 681 (Ga 1932).

Descriptors: \*Georgia, \*Cities, \*Sewage, \*Ditches, Mosquitoes, Public health, Real property, Legal aspects, Judicial decisions, Adjudication

Plaintiff landowners sought to enjoin defendant city from maintaining an open sewage ditch. Plain-tiff alleged that the ditch was a nuisance as tiff alleged that the ditch was a nuisance as malodorous and a breeding place for mosquitoes. Defendant contended that since the ditch was present when plaintiff purchased his land, plaintiff took title subject to defendant's right to maintain the ditch. Defendant also asserted that plaintiff was required to keep the ditch open and repaired. However, the Supreme Court of Georgia held that defendant must abate the nuisance. The verdict of the trial court for the plaintiff was in accordance with the evidence. (Hart-Florida) W71-08771

BOARD OF SUP'RS V CITY OF RICHMOND (RIGHT OF CITY TO CHARGE FOR SEWER

173 SE 356-361 (Va 1934).

Descriptors: \*Virginia, \*Natural flow, \*Diversion, \*Sewers, Conduits, Public health, Drainage, Rivers, Drainage systems, Cities, Sewage disposal, Administrative agencies, Contracts, Costs, Channels, Legal aspects, Judicial decisions.

Plaintiff city brought suit against defendant county board of supervisors to recover sewer charges relati ing to connection of the county with the city's sewer system. Plaintiff contended it was empowered to make the charges by authority of city ordinances and that the connection constituted a diversion of the natural flow of drainage from the county. Defendant contended that the connection followed the natural flow of drainage and that there had been a judicial determination that the county could not be charged for sewer connections under such circumstances. Defendant also contended that the ordinances relied upon by plaintiff were unlawful. The trial court found for plaintiff and the Supreme Court of Appeals of Virginia affirmed. The evidence supported a finding that the sewer connection was a diversion of the natural flow of drainage. The ordinances relied upon by plaintiff amounted to an offer by it to provide sewer services. Defendant knew of the ordinances, and acceptance of the services bound defendant for payment on a theory of implied contract. (Duss-Florida) W71-08773

ORSANCO: PIONEER WITH A NEW MISSION, For primary bibliographic entry see Field 05G. W71-08825

### 6F. Nonstructural Alternatives

THE EAST-WEST WATER CONTROVERSY: BOTH SIDES ARE PARTLY RIGHT, Stanford Univ., Calif.
For primary bibliographic entry see Field 06B.

W71-08820

### 6G. Ecologic Impact of Water Development

CALIFORNIA'S TIDELAND TRUST: SHORING

For primary bibliographic entry see Field 06E. W71-08430

AN ACT ESTABLISHING THE FLORIDA EN-VIRONMENTAL INVENTORY COUNCIL. For primary bibliographic entry see Field 06E.

ECOLOGICAL AND PHYSIOLOGICAL IMPLICATIONS OF GREENBELT IRRIGATION: FIRST ANNUAL REPORT OF THE MALONEY CANYON PROJECT, California Univ., Riverside. Dept. of Agronomy.

J. R. Goodin, and W. D. Kesher.
University of California at Riverside, W-236, July 1970 40 p. 7 tab. 8 fg. 31 ref. OWER Project R.

1970. 40 p, 7 tab, 8 fig, 31 ref. OWRR Project B-090-CAL (1).

Descriptors: \*Water reuse, \*Ecology, \*Environmental effects, \*Physiological ecology, \*Vegetation establishment, California, Population, Water supply, Waste disposal, Chaparral, Instrumentation, Plant groupings, Animal groupings, Land clearing, Irrigation programs, Deer, Bird types, Rodents, Experimental farms, Sewage, Sprinkler irrigation, Automatic control, Implied benefits.

Identifiers: \*Fire hazards, \*Water-related problems, Rabbit, Coyote, Wood rat, \*Greenbelts, Maloney Canyon (San Bernadino National Forest).

Water-related problems of the increasing southern California population include fire hazard, water supply, and waste disposal. A chaparral-covered ridge in Maloney Canyon, San Bernardino National Forest, was instrumented to study species composition before and after clearing, irrigation and introduction of new species. There are 70 vegetation species in the study area. Deer, rabbit, coyote, wood rat, birds and small rodents were inventoried. Forty-eight experimental plots were developed, 100 feet by 200 feet, for irrigation and introduction of 24 new plant species. Thirty-six plots will be irrigated with sewage, under automatic sprinkler control. The project is sponsored by 6 cooperators. Tables list species and water analyses. Figures show location, plot views, work crews, and treatment plant. (Popkin-Arizona) W71-08491

# ENVIRONMENTAL PROTECTION--TVA EX-

PERIENCE,
Tennessee Valley Authority, Chattanooga.
F. E. Gartrell, and J. C. Barber.

Proceedings, American Society of Civil Engineers, Journal of the Sanitary Engineering Division, Vol 96, No SA6, p 1321-1334, Dec 1970. 14 p, 9 fig, 7 ref, append.

Descriptors: \*Agriculture, Environmental engincering, \*Environmental effects, \*Fertilizers, Fly sh, Natural resources, Nuclear powerplants, Nutrients, Wastes, \*Sanitary engineering, Waste heat, Water pollution, Air pollution, \*Pollution abatement, Solid wastes, \*Ecology, Research and development, Thermal powerplants, Air pollution control

Identifiers: Nuclear debris, Tennessee Valley Authority, Sulfur dioxide.

The Tennessee Valley Authority has been engaged in environmental protection since the agency was created in 1933, as a result of TVA's responsibility for development and protection of the resources in the Tennessee Valley and for improvement in agricultural practices and education. Several environmental protection projects that function as parts of the program for agricultural development and powerplant operation include: (1) studies of nuisance weed growth in reservoirs, (2) measurement of nutrient discharge from agricultural lands, (3) development of fly ash control methods, (4) research on sulfur dioxide removal from powerplant stack gases, and (5) investigation of environ-mental effects of waste heat from nuclear powerplants. Environmental protection is demonstrated at fertilizer production units operated by TVA. Also, other fertilizer producers are assisted with environmental problems because some TVA fertilizers possess properties useful in control of wastes in air. In cooperation with another Government agency, treatment and utilization of municipal

waste as a soil amendment are being investigated. (USBR) W71-08640

ECOLOGICAL EFFECTS OF POWER-PLANT COOLING, Oak Ridge National Lab., Tenn. Ecological

Sciences Div. For primary bibliographic entry see Field 05C. W71-08762

POSSIBLE EFFECTS OF A SEA-LEVEL CANAL ON THE MARINE ECOLOGY OF THE AMERICAN ISTHMIAN REGION,

Battele Memorial Inst., Columbus, Ohio. Columbus

For primary bibliographic entry see Field 05C. W71-08763

MONITORING ECOLOGICAL CHANGES IN THE MARINE ENVIRONMENT, Clapp (William F.) Labs., Inc., Duxbury, Mass. For primary bibliographic entry see Field 05A.

NATIONAL POLICY FOR COASTAL MANAGE-MENT,

Washington Univ., Seattle.

For primary bibliographic entry see Field 06E. W71-08770

BIOLOGICAL AND OCEANOGRAPHICAL SURVEY OF THE SANTA BARBARA CHANNEL OIL SPILL 1969-1970, VOLUME I: BIOLOGY AND BACTERIOLOGY; VOL II: PHYSICAL, CHEMICAL AND GEOLOGICAL STUDIES

University of Southern California, Los Angeles, Allan Hancock Foundation.

For primary bibliographic entry see Field 05C.

ECO-ENGINEERING - THE CHALLENGE OF RESOURCE DEVELOPMENT,

California Dept. of Fish and Game, Stockton. For primary bibliographic entry see Field 06B.

### 07. RESOURCES DATA

### 7A. Network Design

THE NATIONAL HYDROLOGIC BENCH-MARK NETWORK, Geological Survey, Washington, D.C. Ernest D. Cobb, and J. E. Biesecker.

Free on application to the US Geological Survey, Washington, DC, 20242. Geological Survey Circular 460-D, 1971. 38 p, 2 fig, 7 ref.

Descriptors: \*Bench marks, \*Networks, \*Hydrologic data, \*Data collections, \*United States, Hydrology, Hydrologic cycle, River basins, Streamflow Groundwater and Groundwate Streamflow, Groundwater movement, Water quality, Water yield, Precipitation (Atmospheric), Geology, Topography, Climates, Vegetation, Stream gages, Flow characteristics, Water temperature, Aquifer characteristics, Aquifers, Net-

Identifiers: \*Hydrologic bench-mark network.

hydrologic bench-mark network was established to provide data on stream basins which are not expected to be significantly altered by man. Data obtained from these basins can be used to document natural changes in hydrologic characteristics with time, to provide a better understanding of the hydrologic structure of natural basins, and to provide a comparative base for studying the effects of man on the hydrologic environment. There are 57 bench-mark basins in 37 States. These basins are in areas having a wide variety of climate and topography. The bench-mark basins and the types of data collected are described regarding location, drainage area, physiographic area, flow characteristics, climate, topography, rock type, vegetation, streamflow, manmade influences, stream gage location, water quality, groundwater, and special characteristics. (Woodard-USGS) W71-08327

NATIONAL SYMPOSIUM ON DATA AND IN-STRUMENTATION FOR WATER QUALITY MANAGEMENT.

For primary bibliographic entry see Field 05A. W71-08550

BASIC DATA REQUIREMENTS TO EVALUATE WATER POLLUTION IN QUALITY CONTROL PROGRAMS, NUS Corp., Pittsburgh, Pa. Cyrus William Rice

For primary bibliographic entry see Field 05A. W71-08553

LESSONS TO BE LEARNED WHEN COLLECT-

ING VALID DATA, Manhattan Coll., Bronx, N.Y. Dept. of Civil En-

For primary bibliographic entry see Field 05A. W71-08555

EXPERIENCES WITH AUTOMATION IN REMOTE SAMPLING AND ANALYSIS OF SUR-FACE WATERS,
American Chain and Cable Co., Glen Cove, N.Y.

Bristol Datamaster Div.

For primary bibliographic entry see Field 05A. W71-08556

DATA NEEDS IN ENGINEERING DESIGN,

Datagraphics, Allision Park, Pa. For primary bibliographic entry see Field 05A. W71-08559

NEED FOR WATER QUALITY DATA IN OPERATING WATER IMPOUNDMENTS,
Bureau of Reclamation, Washington, D.C. Div. of

Water and Land Operations. For primary bibliographic entry see Field 05A. W71-08560

FUNDAMENTALS OF SYSTEMS DESIGN, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 05A.

TELEMETRY - STATE-OF-THE-ART,

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 05A. W71-08873

DESIGN OF AN AUTOMATIC MONITORING

Geological Survey, Austin, Tex. Water Resources

For primary bibliographic entry see Field 05A. W71-08874

EXPERIENCES WITH OPERATING AN AUTO-MATIC WATER QUALITY MONITORING SYSTEM IN AN ESTUARINE ENVIRONMENT, Federal Water Quality Administration, Edison, N.J. Hudson-Delaware Basins Office. For primary bibliographic entry see Field 05A. W71-08875

NEW YORK STATE AUTOMATIC WATER QUALITY MONITORING SYSTEM, New York State Dept. of Health, Albany. Water

Quality Surveillance Section. For primary bibliographic entry see Field 05A. W71-08876

AUTOMATED STREAM QUALITY SENSING NETWORK IN NEW JERSEY,
Geological Survey, Trenton, N.J. Water Resources

For primary bibliographic entry see Field 05A. W71-08877

ORGANIZING A DATA COLLECTION PRO-GRAM FOR WATER RESOURCES PLANNING, DEVELOPMENT AND MANAGEMENT, Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 05A. W71-08883

A WATER QUALITY INDEX - DO WE DARE,

National Sanitation Foundation, Ann Arbor, Mich; and Michigan Univ., Ann Arbor. School of Public Health; and Michigan Univ., Ann Arbor. School of Natural Resources

For primary bibliographic entry see Field 05A.

APPLICATION OF ELECTRONIC MONITORS TO RIVER QUALITY FORECASTING,
Ohio River Valley Water Sanitation Commission,

Cincinnati. For primary bibliographic entry see Field 05A. W71-08886

POTENTIAL BENEFITS OF MATHEMATICAL MODELS AND COMPUTERS FOR WATER QUALITY MANAGEMENT PROGRAMS, New York Univ., N.Y. Dept. of Civil Engineering.

For primary bibliographic entry see Field 05A. W71-08892

PROPOSED STREAMFLOW DATA PRO-GRAM FOR NORTH CAROLINA,

Geological Survey, Raleigh, N.C. G. C. Goddard, Jr., N. M. Jackson, Jr., E. F. Hubbard, and H. G. Hinson.

Geological Survey Open-File Report, 1970. 69 p, 2 fig, 1 plate, 9 tab, 19 ref, 2 append.

Descriptors: \*Streamflow, \*Network design, \*Stream gages, \*Programs, \*North Carolina, Planning, Regression analysis, Flow rates, Data collections, Flow characteristics, Flow measurement, Base flow, Peak discharge, Gaging stations, Surface waters, Equations

The proposed streamflow data program was based on an evaluation of the present program. This evaluation included classification of data needed, the setting of accuracy goals, and the analysis of data to determine if these goals had been met and to determine in what ways the program could be strengthened. Seventeen stations on primary streams (having drainage areas greater than 500 square miles) have adequate record to define streamflow characteristics and may be discontinued. Five new stations are needed to complete the primary network. Of 175 stations in operation, 7 stations are designated as long-term and 56 as current-purpose stations. Recommendations for expanded or new hydrologic studies include: (1) determination of time of travel and dispersive characteristics of streams, (2) investigation of public water supplies, and (3) expanded study and interpretation of data collected during periods of low streamflow. (Woodard-USGS) W71-08932

A SYSTEM FOR DETECTING FLUORESCENT TRACERS IN STREAMFLOW,

Bureau of Reclamation, Denver, Colo. Engineering and Research Center.

and Research Center.
H. W. Steppuhn.
Available from the National Technical Information
Service as PB-197 866, \$3.00 in paper copy, \$0.95
in microfiche. PhD Thesis, December 1970, 190p,
64 fig, 11 tab, 77 ref, append. Bureau of Reclamation Contract 14-06-DO-6598.

Descriptors: Tracers, \*Streamflow, Hydrologic instruments, Theoretical analysis, Diffusion, Films, Gages, Gaging stations, Chemical properties, \*Hydrographs, Experimental data, \*Measurement, Sorption, Bibliographies, Accuracy, Velocity, Streamflow records.

Identifiers: Stream temperature, \*Fluorescent

A system to monitor continuously the relative concentration of a fluorescent tracer in streamflow was developed. Streamside instrumentation automatically registers streamborne tracer concentrations as a function of time on a gelatin-coated film. The film is routed through a device which passes a continuous sample-aliquot diverted from the tracertinuous sample-anquot diverted from the tracer-dosed stream over a small segment of the film. The exposed film is gathered periodically from streamsites and analyzed in a laboratory-based fluorometer. Use of the system is studied for gaging streamflow to: (1) produce a hydrograph, (2) mea sure stream discharge instantaneously, and (3) determine time-of-stream-travel. Hydrographs resulting from 640 hr of gaging 2 Colorado mountain streams with the system are compared to those obtained from closely located sharp-crested weirs. obtained from closely located sharp-crested werrs. The maximum instantaneous deviation between hydrographs reaches 10%, the average absolute departure equals 1.8%, and the algebraic departure averages plus 0.3%. The system can be used when an expensive, temperature-sensitive fluorometer cannot be stationed streamside, and when the particular distribute of the stationed streamside, and when the particular distribute of the stationed streamside, and when the particular distribute of the stationed streamside, and when the particular distribute of the stationed streamside, and when the particular distribute of the stationed streamside, and when the particular distribute of the stationed streamside, and when the particular distribute of the stationed streamside and the streamsid ticular objectives of stream measurements do not justify the cost of conventional techniques, but fair accuracy and continuous records of short to moderate duration are desired. W71-08940

### 7B. Data Acquisition

A NEW SYSTEM FOR THE AUTOMATIC MEASUREMENT AND RECORDING OF RAINFALL, Royal Aircraft Establishment, Farnborough (En-

gland). C. F. Lucas.

Available from the National Technical Information Service as AD-714 936, \$3.00 in paper copy, \$0.95 microfiche. Royal Aircraft Establishment Technical Report 70051, Mar 1970. 13 p, 7 fig, 1 ref.

\*Rain gages, \*Instrumentation, Telemetry, Data storage and retrieval, Equipment, Gages, Precipitation gages, Gaging stations. Identifiers: Rain gages (Recording).

A system was developed to meet a need for a simple, accurate, automatic recording rain gage with a high degree of reliability. It is capable of recording very light falls of rain or drizzle and of handling the heaviest falls. Also, it can store the information within the gage itself, send the information out electrically, or be interrogated by telephone or radio, or all of these. The new gage is very suitable for incorporation in automatic data logging systems, and when so used can provide an accurate combined record of the time of onset and cessation of rain, the rate of rainfall, the quantity in each shower, and total rainfall. They have an efficiency between 99% and 110% compared to the 5 inch check gage, have a much greater resolution than existing recording rain gages and can be left unattended for long periods. In addition, the total rainfall can be retained for check purposes. Evaporation is reduced considerably, no losses occur during emptying, the mechanism is generally strong, no highly toleranced or critically balanced parts are

### Field 07—RESOURCES DATA

### Group 7B—Data Acquisition

required, and the overall cost of manufacture is low. (KnappdUSGS) W71-08339

PHOTOIN-**AERIAL** APPLICATION OF APPLICATION OF AERIAL PHOTOINTERPRETATION METHODS IN HYDROLOGICAL STUDIES WITH SPECIAL REFERENCE TO THE PROBLEMS IN EASTERN INDIA, Geological Survey of India, Calcutta.

Amit Kumar Roy. Indian Geohydrology, Vol 5, No 1, p 58-64, Dec 1969. 7 p, 7 ref.

Descriptors: \*Photogrammetry, \*Aerial photography, \*Hydrologic data, \*Data collections, Topography, Mapping, Geomorphology, Surveys, Water resources development, Reviews, Hydrology, Hydrogeology, Drainage patterns (Geologic). Identifiers: \*India.

In the major river valleys of Eastern India and in the coastal plains of West Bengal and Orissa, photogeological studies are considered very advantageous in tackling various hydroproblems. Photointerpretation methods used in hydrological studies are reviewed. Aerial photographs present a three dimensional picture of land surface, which with properly chosen scale and good resolution provides information on geomorphological fea-tures, drainage characteristics, rock and soil types, geological structures and nature and pattern of vegetation of a wide area. Demarcation of various fluviatile environments such as flood plain, backswamp, meander belt, etc. is possible on the basis of such studies. (Knapp-USGS) W71-08341

## THE USE OF WELL LOGGING IN RECHARGE STUDIES OF THE OGALLALA FORMATION, Geological Survey, Lubbock, Tex.

For primary bibliographic entry see Field 02F. W71-08352

# UPWELLING, COLUMBIA RIVER PLUME AND

ALBACORE TUNA,
Oregon State Univ., Corvallis. Dept. of Oceanog-

William G. Pearcy, and James L. Mueller.
Proceedings 6th International Symposium on Remote Sensing of Environment, Michigan University, Ann Arbor, Oct 13-16, Vol 2, p 1101-1113, 1970. 13 p, 7 fig, 3 ref. U. S. Bur. of Commercial Fisheries. Contract No 14-17-0002-333.

Descriptors: \*Columbia River, \*Discharge (Water), \*Pacific Ocean, \*Remote sensing, Instrumentation, Aircraft, Aerial photography, Tempera-ture, Color, Analytical techniques, Fish, Oregon, Coasts, River flow, Winds. Identifiers: \*Infrared radiometers, \*Multispectral scanner, \*Upwelling, \*Columbia River plume.

Infrared radiometers, photographs, and a multispectral scanner, were used in a remote sensing study of the ocean off Oregon during the summer of 1969. Upwelling appeared on infrared temperature maps as a zone of cold water along the coast and Columbia River water appeared as a warm water 'plume'. Sharp temperature and color fronts were common. The areal temperature and color fronts were common. The areal temperature pattern was complex and changed rapidly, undoubtedly influencing the migration and distribution of albacore tuna in Oregon waters. (Woodard-USGS) W71-08358

## INFRARED EXPLORATION FOR SHORELINE SPRINGS AT MONO LAKE, CALIFORNIA, TEST SITE.

Colorado School of Mines, Golden. Dept. of Geology.

Keenan Lee.

Proceedings 6th International Symposium on Remote Sensing of Environment, Michigan University, Ann Arbor, Oct 13-16, 1969, Vol 2, p 1075-1100, 1970. 26 p, 16 fig, 1 tab, 16 ref. USGS Contract 14-08-0001-11217.

Descriptors: \*Water resources development, \*Remote sensing, \*Surface waters, \*Lakes, Shores, Springs, Aircraft, Instrumentation, Infrared radiation, Temperature, Flow rates, Streams, Radio waves, Analytical techniques.

Identifiers: \*Radiometer, Bendix scanner.

Remote sensing methods offer the potential for rapid aerial exploration for water resources. This research investigated one aspect of this potential, namely the ability of a non-classified, airborne infrared scanner to detect and evaluate shoreline springs. Infrared data were collected on four different missions using the Bendix scanner. The test site contained numerous fresh water springs of varisite contained numerous fresh water springs of various temperatures and rates of flow which discharged around and under Mono Lake. Mono Lake is a large saline lake and was therefore analogous to a marine situation. The volumetric discharge from shoreline springs at Mono Lake can be estimated from infrared imagery if air temperature at ground-level is known. Empirically derived towasticities correlation methods derived from a quantitative correlation methods, derived from a quantitative correlation methods, derived from a study of imagery anomalies from 7 springs, estimated the discharge rates of 11 other springs using imagery data. These methods apply to small streams as well as to shoreline springs. (Woodard-USGS) W71-08359

# THE EFFECT OF SEA ROUGHNESS ON THE BANDWIDTH OF RADAR BACKSCATTER,

Hulburt (E.O) Center for Space Research, Washington, D.C. Donald L. Hammond.

Proceedings 6th International Symposium on Remote Sensing of Environment, Michigan University, Ann Arbor, Oct 13-16, 1969, Vol 2, p 797-806, 1970. 10 p, 6 fig, 2 ref.

Descriptors: \*Oceanography, \*Remote sensing, Surface Instrumentation, waters, Methodology, Aircraft, Data collections, Mathematical studies, Equations, Ocean waves, Computer programs. Identifiers: \*Sea roughness, Ocean surface.

The doppler signals of an eight millim aircraft radar navigation system were analyzed to determine the effect of sea roughness on the bandwidth of the radar backscatter. The ground truth giving the wave heights were obtained by estimates made by the scientists aboard the aircraft and hindcast of the sea conditions based on weather records. The results are given in terms of a factor called 'Q' which varies inversely with bandwidth and is independent of aircraft altitude and velocity. When the data are arranged in the order of increasing wave heights, there is a trend of decreasing 'Q' with increasing wave height. (Woodard-USGS) W71-08360

### DETECTION OF OIL SLICK POLLUTION ON WATER SURFACES WITH MICROWAVE RADIOMETER SYSTEMS,

Microwave Sensor Systems, Inc., Downey, Calif.; and California Univ., Santa Barbara. For primary bibliographic entry see Field 05A. W71-08361

### OCEANOGRAPHIC APPLICATIONS REMOTE SENSING WITH PA MICROWAVE TECHNIQUES, OF **PASSIVE**

Aerojet-General Corp., El Monte, Calif A. T. Edgerton, and D. T. Trexler.

Proceedings 6th International Symposium on Remote Sensing of Environment, Michigan University, Ann Arbor, Oct 13-16, 1969, Vol 2, p 767-788, 1970. 22 p, 16 fig, 8 ref.

Descriptors: \*Oceanography, \*Remote sensing, \*Microwaves, \*Radio waves, Methodology, Aircraft, Oceans, Pollutant identification, Water temperature, Salinity, Sea ice, Sea spray, Oil-water interfaces, Surface waters, Ocean waves Identifiers: \*Microwave radiom Identifiers: radiometry, roughness, Ocean surface.

Passive remote sensing in the microwave spectral region is a useful tool for determination of oceanoregion is a userul tool for determination of oceano-graphic phenomena such as sea state, pollution, and sea ice characteristics. Differences in radiometric brightness temperature of the sea sur-face on the order of 15 deg K have been readily de-tected during airborne measurements of the Salton Sea, California and the North Atlantic. Oil base Sea, California and the North Atlantic. Oil base pollutants on the ocean surface radically affect the radiometric response because of the distinctly different dielectric properties of the oil as compared to water. Salinity variations in sea water between 30,000 and 35,000 ppm are detectable with long wavelength radiometers. Another application of microwave radiometry is the delineation of various sea ice types based on surface roughness, thermal gradient in the ice, and the presence or absence of gradient in the ice, and the presence or absence of brine pockets. (Woodard-USGS)

# MULTISPECTRAL SENSING OF OIL POLLU-

TION, Michigan Univ., Ann Arbor. For primary bibliographic entry see Field 05A. W71-08363

# THE REMOTE SENSING OF THE SEA AND

Naval Research Lab., Washington, D.C.

N. W. Guinard.

Proceedings 6th International Symposium on Remote Sensing of Environment, Michigan University, Ann Arbor, Oct 13-16, 1969, Vol 2, p 737-754, 1970. 18 p, 12 fig, 1 tab, 9 ref.

Descriptors: \*Oceanography, \*Remote sensing, \*Data collections, \*Radar, \*Atlantic Ocean, Aircraft, Sea ice, Sea water, Surface waters, Ocean Identifiers: \*Sea roughness, Ocean surface.

The Naval Research Laboratory has developed a unique data collection facility, the Four-Frequency Radar (4FR) System which is an experimental radar installed in an EC-121 (Super Constellation) aircraft. The system has a wavelength capability spanning the range from UHF to X band, with linear polarization diversity, pulsewidth and repeti-tion rate flexibility and the ability to illuminate terrain and targets at various angles of incidence and with near simultaneity. This system was used to measure the radar returns scattered from both sea and ice surfaces both for the purpose of identifying sea states and ice types and to determine effective models of the scattering processes to aid in the design of optimum sensors. Data collected over the ocean in low sea states at Puerto Rico and in the higher sea states observed in the North Atlantic were used to verify the predictions of the slightly rough surface model. Polar ice was mapped in synthetic aperture mode to determine roughness and contour. Some penetration effects are noted. (Woodard-USGS) W71-08364

# REMOTE SENSING OF THE SEA CONDITIONS WITH MICROWAVE RADIOMETER SYSTEMS, Microwave Sensor Systems, Inc., Downey, Calif., and RCA Corp., Princeton, N.J. J. C. Aukland, P. J. Caruso Jr., W. H. Conway, and

R. G. Groshans.

Proceedings 6th International Symposium on Remote Sensing of Environment, Michigan University, Ann Arbor, Oct 13-16, 1969, Vol 2, p 709-719, 1970. 11 p, 5 fig, 3 tab, 3 ref.

Descriptors: \*Oceanography, \*Remote sensing, \*Instrumentation, \*Data collections, Meteorology, Mathematical studies, Water temperature, Aircraft, Radio waves, Microwaves, Radiation, Atmospheric physics, Surface waters, Ocean waves. Identifiers: \*Sea roughness, Ocean surface.

Information about the condition of the sea surface is of major importance to shipping, fishing, and naval operations. Likewise, other oceanographic activities and meteorological analyses and forecasts

### Data Acquisition—Group 7B

require sea surface data across the full expanse of the oceans. Two of the important parameters are sea state and sea-surface temperature. A microwave radiometric experimental program is discussed. The purpose of the program was to generate curves relating sea state and sea-surface temperature to apparent radiometric temperatures, providing the basic data to be used with remote microwave radiometric measurements for determining sea state and sea-surface temperature. The ground based measurements indicate that foam and surface ripple must be considered in any system measuring sea state or sea temperature. The presence of foam significantly modifies the radiometric temperature by 20 - 100 deg, depending upon the quantity of foam in the beam. The measurements further point out the need for airborne measurements to generate curves for sea state determination. (Woodard-USGS) W71-08365

TIME-SPACE VARIATIONS OF THE GULF STREAM AS OBSERVED BY AIRBORNE REMOTE SENSING TECHNIQUES, **AIRBORNE** 

Naval Oceanographic Office, Washington, D.C. J. C. Wilkerson, and V. E. Noble.

Proceedings 6th International Symposium on Remote Sensing of Environment, Michigan University, Ann Arbor, Oct 13-16, 1969, Vol 2, p 671-708, 1970. 38 p, 16 fig, 2 tab, 5 ref.

Descriptors: \*Ocean circulation, \*Ocean currents, \*Atlantic Ocean, \*Gulf of Mexico, \*Tracking techniques, Remote sensing, Water temperature, Aircraft, Bathythermographs, Data collections, Methodology, Isotherms, Surface waters. Identifiers: \*Gulf streams, Time-space variations.

During May to July 1969, 22 aerial surveys of the Gulf Stream were made. During the tracking missions, the significant sea surface temperature front delineating Gulf Stream water from Slope Water (usually defined by the surface packing of the 21 -26 deg C isotherms) was located with a remote sensing radiation thermometer. Starting at the east coast between longitudes 75 deg W and 73 deg W, the boundary was tracked downstream to longitudes between 65 deg W and 60 deg W. During periods of rapid motions of the meanders of the Gulf Stream, some segments of the surface temperature front defining its position moved as much as 20 km/day. Bathythermograph data showed that the surface position being tracked during flight was parallel to and, in general, 20-50 km shoreward of the Gulf Stream position at the 200-meter depth. In this region, Gulf Stream water overran Slope Water, producing very shallow layer depths usually less than 20 meters. (Woodard-USGS) W71-08366

#### REMOTE SENSING IN SOUTH DAKOTA. South Dakota State Univ., Brookings.

South Dakota Farm and Home Research, Vol 20, No 1, Winter 1969, p 9-11, 36, 4 fig.

Descriptors: \*Remote sensing, \*Land classifica-tion, \*Resource planning, \*Aerial photography, Crop response, Plant diseases, Insect behavior, Water management (Applied), Geological studies, South Debote Scalemant (Applied), Geological studies, South Dakota, Soil-water-plant relationships, Soil surveys, Analysis, Soil moisture, Salinity, Moisture stress, Fertilization, Irrigation practices, Mapping,

Identifiers: \*Condition mapping, \*Crop surveys, Dutch elm disease, Wheat rust

An institute of remote sensing was established at South Dakota State University for Dutch elm disease detection, wheat rust and other plant or insect pests detection, land classification, moisture and irrigation surveys. Computer-oriented data will be used for agricultural research, resource planning and management. The U.S. Department of Interior will support hydrologic and geologic studies. The U.S. Department of Agriculture will support crop and soil investigations. A twin-engined airplane will

take aerial photographs from 3,000 to 10,000 feet, which will be interpreted by specialists. NASA aircraft equipment will be used to map soil moisture, land classification, irrigation and salinity, plant stress and pollution. Fertilization and irrigation practices may be better managed by 'condition mapping' of the land resource. Four photographs show tree disease infection, aircraft instrumentation, soil types, and mosquito surveys. (Popkin-Arizona) W71-08487

# THE ACOUSTIC STREAMFLOW-MEASURING SYSTEM ON THE COLUMBIA RIVER AT THE DALLES, OREGON, Geological Survey, Portland, Oreg. Winchell Smith, Larry L. Hubbard, and Antonius

Geological Survey Open-file Report, Jan 1971. 60 p, 32 fig, 5 tab, 10 ref.

Descriptors: \*Flowmeters, \*Streamflow, \*Columbia River, \*Oregon, \*Acoustics. Methodology, Equipment, Instrumentation, Stream gages, Discharge measurement, Flow rates, Dams, Non-uniform flow.

Identifiers: \*The Dalles (Oreg), \*Acoustic velocity

Because dams control watersurface elevations in the Columbia River from Bonneville Dam to the Canadian border, conventional stream-gaging methods, used historically, are no longer adequate. An acoustic streamflow-measuring system in the river channel at The Dalles, Oreg, provides an index of water velocity by measuring the difference in travel times of acoustic pulses transmitted through the water in each direction along a diagonal path across the river. The flow of water along the path increases the speed of one signal and retards the speed of the other. The difference in time of travel is related linearly to the water velocity along the path. The velocity index and river stage are used as a two-variable index in the computation of flow. These variables, correlated against current-meter measurements made with specialized boat equipment, provide a reliable basis for computations of instantaneous and daily mean discharges. This report covers the general theory behind acoustic velocity meters. Conclusions are that the AVM can now be considered as an operational instrument which permits accurate gaging of river discharge at many sites where conventional stream-gaging procedures have proved to be unreliable. (Woodard-USGS) W71-08522

### OPEN-CHANNEL INTEGRATING-TYPE FLOW METER.

Geological Survey, Albuquerque, N. Mex. F. C. Koopman.

Geological Survey Open-file Report, Apr 1971. 25 p, 5 fig, 3 tab, 2 ref.

Descriptors: \*Flowmeters, \*Flow measurement, Flow rates, Instrumentation, Gages, Water mea-

surement, Electrolysis. Identifiers: \*Flowmeters (Integrating).

A relatively inexpensive meter was developed for measuring cumulative flow in open channels with a rated control. It translates the nonlinear function of gage height to flow by use of a cam and a float. A variable resistance element in an electronic circuit is controlled by the float so that the electric current in the circuit corresponds to the flow of water. The flow of electricity causes electroplating with silver; the amount of silver deposited is proportionate to the total flow of water. A device was developed to measure the total amount of silver electrolytically. (Knapp-USGS) W71-08525

EXPERIENCES WITH AUTOMATION IN REMOTE SAMPLING AND ANALYSIS OF SUR-FACE WATERS,

American Chain and Cable Co., Glen Cove, N.Y.

For primary bibliographic entry see Field 05A. W71-08556

# PYROGRAPHIC GROSS CHARACTERIZATION AND MONITORING OF WATER POLLU-

Rocketdyne, Athens, Ga. Southeast Field Lab. For primary bibliographic entry see Field 05A. W71-08561

# APPLICATION OF REMOTE SENSING TO WATER QUALITY MANAGEMENT, Ecology and Environment, Inc., West Seneca, N.

For primary bibliographic entry see Field 05A. W7i-08562

# ORGANIZING A DATA COLLECTION PRO-

Bureau of Reclamation, Sacramento, Calif. For primary bibliographic entry see Field 05A. W71-08565

## COMPATIBILITY OF SYSTEMS AND IN-TERCHANGE OF DATA, Geological Survey, Washington, D.C. Water

Resources Div.

For primary bibliographic entry see Field 05A. W71-08566

# EXPERIENCES WITH A WATER POLLUTION CONTROL STORAGE AND RETRIEVAL SYSTEM (STORET), Federal Water Quality Administration, Washing-

ton, D. C. Pollution Surveillance Branch. For primary bibliographic entry see Field 05A. W71-08567

# EXPERIENCE WITH STORAGE AND RETRIEVAL OF GROUNDWATER DATA, Geological Survey, Washington, D. C. Water

Resources Div.

For primary bibliographic entry see Field 05A. W71-08568

## A WATER QUALITY STORAGE AND RETRIEVAL SYSTEM FOR REGIONAL APPLI-CATION.

Texas A and M Univ., College Station. For primary bibliographic entry see Field 05A. W71-08569

### PROJECT HYDRA,

John N. Spinning. Military Engineer, Vol 63, No 412, p 82-84, Mar-Apr 1971, 3 p, 4 fig.

Descriptors: \*Surveys, \*Hydrography, \*Telemetry, \*Instrumentation, \*Mapping, \*Measurement, Sounding, Oceanography, Bathymetry, Profiles, Terrain analysis, Topography, Automation. Identifiers: \*Automatic survey systems.

The HYDRA Survey System was developed for use in river, harbor, and near-shore surveys. Such marine areas often present difficult survey problems because of unusual local conditions or logistic support limitations. The new system provides the user with maximum mobility, yet requires the minimum of logistic support. The HYDRA Survey System is a lightweight, portable, digital hydrographic data acquisition package suitable for temporary installation aboard a wide variety of craft without modification to either the equipment or survey platform. Thus it permits use of indigenous craft or standard survey launches. Survey data con-

### Field 07—RESOURCES DATA Group 78—Data Acquisition

sisting of electronic coordinates and water depths correlated with the time of day are recorded on magnetic tape aboard the survey vehicle. (Knapp-USGS) W71-08614

BIOGEOCHEMISTRY OF A RESERVOIR ECOSYSTEM,

CCUSYSTEM,
Oklahoma State Univ., Stillwater. Dept. of Chemistry; and Oklahoma State Univ., Stillwater. Dept. of Zoology; and Oklahoma State Univ., Stillwater. Reservoir Research Center.
For primary bibliographic entry see Field 05A.
W71-08685

OIL POLLUTION DETECTION AND DISCRIMINATION BY REMOTE SENSING SENSING TECHNIQUES,

Spectran, Inc., Buena Park, Calif. Microwave Sensor Systems Div.

For primary bibliographic entry see Field 05A. W71-08745

AERIAL PHOTOGRAPHIC STUDIES OF THE COASTAL WATERS OF NEW YORK AND LONG ISLAND,

Virginia Univ., Charlottesville. Dept. of Environmental Science; New York Univ., Bronx. Dept. of

For primary bibliographic entry see Field 05A. W71-08746

TELEVISION - A NEW TOOL FOR THE GROUNDWATER GEOLOGIST,

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 04B. W71-08815

PULP MILL OUTFALL ANALYSIS BY REMOTE SENSING TECHNIQUES, Oregon State Univ., Corvallis. Dept. of Civil En-

gineering. For primary bibliographic entry see Field 05B. W71-08829

AN AERIAL PHOTOGRAPHIC STUDY OF WASTE FIELD FROM THREE OCEAN OUT-FALLS.

Oregon State Univ., Corvallis. Dept. of Civil Engincering.

or primary bibliographic entry see Field 05B. W71-08831

THE USE OF PHOTOGRAMMETRY IN PRE-

DICTING OUTFALL DIFFUSION,
Oregon State Univ., Corvallis. Dept. of Civil Engincering.

For primary bibliographic entry see Field 05B. W71-08832

AN INFRARED DE-ICING UNIT FOR CUP ANEMOMETERS, Rocky Mountain Forest and Range Experiment

Station, Fort Collins, Colo.

Arthur Judson

USDA Forest Serv Res Note RM-187, 1971. 4 p, il-

Descriptors: \*Instrumentation, \*Anemometers, Deicers, Colorado.

\*Mountain winds, \*Icing, Severe

Electric infrared lamps yielding 0.5 watt radiant energy per square centimeter of cup surface prevented icing on an exposed mountain anemometer in Colorado. The unit performed well during all rime conditions for two consecutive winters. Parts for the inexpensive unit are commercially available. W71-08846

RADIOISOTOPES IN TRACING RESERVOIR LEAKAGE AT ANCHOR DAM,
Bureau of Reclamation, Denver, Colo. Chemical

Engineering Branch.
For primary bibliographic entry see Field 08B.

SENSORS - STATE-OF-THE-ART, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 05A. W71-08872

ESTIMATING EVAPOTRANSPIRATION - AN **EVALUATION OF TECHNIQUES.** 

Australian Water Resources Council, Canberra. For primary bibliographic entry see Field 02D. W71-08930

### 7C. Evaluation, Processing and **Publication**

WATER RESOURCES DATA FOR COLORADO, 1969: PART 2. WATER QUALITY RECORDS. Geological Survey, Denver, Colo.

Copies of report may be obtained from District Chief, Water Resources Division, US Geological Survey, Denver Federal Center, Denver, Colorado, 80225. Geological Survey Duplicated Basic Data Report, 1971. 83 p, 1 fig.

Descriptors: \*Water quality, \*Hydrologic data, \*Data collections, \*Surface waters, \*Colorado, Chemical analysis, Streams, Stream gages, Streamflow, Discharge measurement, Sediment transport, Bed load, Sediments, Particle size, Water temperature, Irrigation water, Gaging stations, Bench

Identifiers: \*Water quality records.

Water quality data for surface waters in Colorado for the 1969 water year are presented. Data for a few water quality stations in bordering States are also included. Water quality information is presented for chemical quality, fluvial sediment, and water temperatures. The chemical quality includes concentrations of individual dissolved constituents and certain properties or characteristics such as hardness, sodium-absorption-ratio, specific conductance, and pH. Fluvial sediment informa-tion is given for suspended-sediment discharges and concentrations and for particle size distribu-tion of suspended sediment and bed material. Water temperature data represent once-daily ob-servations except for stations where a continuous temperature recorder furnishes information from which daily minimums and maximums are obtained. Data collected at the irrigation network stations are used to evaluate the chemical quality of surface waters used for irrigation and the changes resulting from the drainage of irrigated lands. (Woodard-USGS) W71-08324

FLOODS IN WILMINGTON QUADRANGLE, NORTHEASTERN ILLINOIS,

NORTHEASTERN ILLINOIS,
Geological Survey, Washington, D.C.
Howard E. Allen, and Allen W. Noehre.
For sale by US Geological Survey, Washington,
DC, 20242, Price \$0.75. Geological Survey Hydrologic Investigations Atlas HA-306, 1 sheet, 1971. Text, 9 fig, 1 map, 2 tab, 2 ref.

Descriptors: \*Floods, \*Flood plains, \*Hydrologic data, \*Flood control, \*Illinois, Streamflow, Flow characteristics, Runoff, Discharge measurement, Stream gages, Peak discharge, Planning, Flood protection, Flood forecasting, Hydrographs. Identifiers: \*Flood measurements, Flood profiles.

This one-sheet atlas contains 12 illustrations and a text concerning hydrologic data that can be used to evaluate the extent, depth, and frequency of flooding that affect the economic development of flood plains in the Wilmington quadrangle, northeastern Illinois. It will aid individuals, government agencies, and others responsible for solving existing flood problems and for formulating effective floodplain regulations that will minimize the creation of new flood problems. The report will also be useful new flood problems. The report will also be useful for preparing building and zoning regulations, locating waste disposal facilities, developing recreational areas, and managing surface water in relation to groundwater resources. The areas inundated by floods along streams in the Wilmington 7.5 minute quadrangle are delineated on a topographic map. (Woodard-USGS) W71-08332

HYDROGEOLOGIC CHARACTERISTICS OF THE VALLEY-FILL AQUIFER IN THE ARKANSAS RIVER VALLEY, BENT COUNTY, COLORADO,

Geological Survey, Denver, Colo. R. Theodore Hurr, and John E. Moore. Geological Survey Open-file Report, Mar 1971. 9

Descriptors: \*Hydrogeology, \*Alluvium, \*Surface-groundwater relationships, Groundwater, Water ta-ble, Bedrock, Saturated flow, Transmissivity, Ir-rigation wells, Water utilization, Colorado. Identifiers: Arkansas River valley, Bent County (Colo), Saturated thickness.

Irrigation wells in a 36-mile reach of the Arkansas River Valley in Bent County, Colo., tap a valley-fill aquifer that occurs in unconsolidated clay, silt, and gravel deposits. The aquifer ranges from 0 to 60 feet thick and 1 to 5 miles wide. The Arkansas feet thick and 1 to 5 miles wide. The Arkansas River is a natural drain for the aquifer and is hydraulically connected with it. The yields of irrigation wells range from 100 gallons per minute to 2,500 gallons per minute. The transmissivity of the aquifer is as much as 40,100 square feet per day. The atlas contains maps at a scale of 1:62,500 showing saturated thickness, configuration of bedrock, depth to water, water-table contours, and transmissivity of the valley-fill aquifer. The transmissivity map was used to construct electrical analog and digital models of the Arkansas River valley. (Lang-USGS)
W71-08333

IN HUNTLEY QUADRANGLE, FLOODS NORTHEASTERN ILLINOIS,

Geological Survey, Washington, D.C. Gerald L. Walter, and Roman T. Mycyk. For sale by US Geological Survey, Washington, DC, 20242, Price \$0.75. Geological Survey Hydrologic Investigations Atlas HA-361, 1 sheet, 1971. Text, 8 fig, 1 map, 3 tab, 2 ref.

Descriptors: \*Floods, \*Illinois, Maps, Profiles, Mapping, Flood forecasting, Frequency analysis, Stage-discharge relations, Data collections, Hydrologic data, Runoff. Identifiers: Huntley (III).

This 1-sheet hydrologic atlas presents hydrologic data that can be used to evaluate the extent, depth, and frequency of flooding that affect the economic development of flood plains in the Huntley quadrangle, northeastern Illinois. It will aid individuals, government agencies, and others responsible for solving existing flood problems and for formulating effective flood-plain regulations that will minimize the creation of new flood problems. The report will also be useful for preparing building and zoning regulations, locating waste disposal facili-ties, developing recreational areas, and managing surface water in relation to the groundwater resources. The approximate areas inundated by floods along streams in the Huntley quadrangle are delineated on a topographic map. Frequency of floods at the Geological Survey gaging station Kishwaukee River at Belvidere, Ill., was derived from streamflow records of this station combined with records for other nearby stations and with the regional flood-frequency relation for streams in North Illinois. Profiles of the water surface for the floods of February 1966 and June 1967 are shown. (Knapp-USGS)

### Evaluation, Processing and Publication—Group 7C

W71-08334

FLOODS IN HEBRON NORTHEASTERN ILLINOIS. OUADRANGLE.

NORTHEASTERN ILLINOIS, Geological Survey, Washington, D.C. Howard E. Allen, and R. Stephen Grant. For sale by US Geological Survey, Washington, DC, 20242, Price \$1.00. Geological Survey Hydrologic Investigations Atlas HA-363, 1 sheet, 1971. Text, 10 fig, 1 map, 2 tab.

Descriptors: \*Floods, \*Illinois, Maps, Profiles, Mapping, Flood forecasting, Frequency analysis, Stage-discharge relations, Data collections, Hydrologic data, Runoff. Identifiers: Hebron (III).

This 1-sheet hydrologic atlas presents hydrologic data that can be used to evaluate the extent, depth, data that can be used to evaluate the extent, depth, and frequency of flooding that affect the economic development of flood plains in the Hebron quadrangle, northeastern Illinois. It will aid individuals, government agencies, and others responsible for solving existing flood problems and for formulating effective flood-plain regulations that will minimize the creation of new flood problems. The minimize the creation of new flood problems. The report will also be useful for preparing building and zoning regulations, locating waste disposal facilities, developing recreational areas, and managing surface water in relation to the groundwater resources. The areas inundated by floods along streams in the Hebron quadrangle are delineated on a topographic map. Inundated areas are shown along Nippersink Creek, De Young Creek, New-man Creek, North Branch Nippersink Creek, and several unnamed streams for the flood of July 1938, along Slough Creek for the flood of March 1943, and along Silver Creek and Vander Karr Creek for the flood of June 1967. Local residents reported that the flood of July 1938 was the highest observed in the past 70 years on Nippersink Creek. Profiles of the water surface for the floods of July 1938, March 1943, February 1966, and June 1967 are shown. Depth of flooding at any point can be estimated by subtracting the ground elevation from the water-surface elevation at the same point, indicated by the profiles. (Knapp-USGS)

# FLOODS IN VICINITY OF ELLIJAY, GEOR-

GIA, Geological Survey, Washington, D.C. McGlone Price.

For sale by US Geological Survey, Washington, DC, 20242, Price \$0.75. Geological Survey Hydrologic Investigations Atlas HA-418, 1 sheet, 1971. Text, 7 fig, 2 map, 2 ref.

Descriptors: \*Floods, \*Georgia, Maps, Profiles, Mapping, Flood forecasting, Frequency analysis, Stage-discharge relations, Data collections, Hydrologic data, Runoff. Identifiers: Ellijay (Ga).

This 1-sheet hydrologic atlas presents hydrologic data that can be used to evaluate the extent, depth, data that can be used to evaluate the extent, depth, and frequency of flooding that may be expected on the Coosawattee, Cartecay, and Ellijay Rivers in the vicinity of Ellijay, Ga. The technical information provided will aid in reaching decisions for sound economic management of flood-plain areas. The areas inundated by floods having recurrence intervals of 5, 25, and 50 years are shown on a topographic map, and the flood boundaries were determined for the present (1969) channel conditional topographic map, and the flood boundaries were determined for the present (1969) channel conditional topographic map. tions. The general procedure used in delineating the flood boundaries for the 5-, 25-, and 50-year floods was to construct flood profiles based on step-backwater studies and on floodmarks identified in the field. Frequency of flooding at the identified in the field. Frequency of flooding at the gaging stations on Cartecay River near Ellijay, Elijay River at Ellijay, and Coosawattee River near Ellijay was derived from a statistical evaluation of annual flood peaks. Profiles of the water surface of Coosawattee, Cartecay, and Ellijay Rivers are shown for hypothetical floods of 5-, 25-, and 50-year recurrence intervals. (Knapp-USGS)

FLOODS IN THE YABUCOA AREA, PUERTO

Geological Survey, Washington, D.C.
Fred K. Fields.
For sale by US Geological Survey, Washington,
DC, 20242, Price \$1.00. Geological Survey
Hydrologic Investigations Atlas HA-382, 1 sheet,
1971. Text, 6 fig, 1 map, 1 tab.

Profiles, Mapping, Flood forecasting, Frequency analysis, Stage-discharge relations, Data collections, Hydrologic data, Runoff.

Identifiers: Yabucoa (Puerto Rico). \*Floods, \*Puerto Rico.

The lower Rio Guayanes basin is virtually unprotected from high-magnitude floods. Two such floods occurred during the period 1936-60. This 1-sheet hydrologic atlas provides factual and interpretive information to aid the planner, designer, any other interested person to reach rational decisions related to land use in the flood plain of decisions related to land use in the flood plain of the lower Rio Guayanes basin. Among the data presented are stream flood profiles and the area of inundation for the September 6, 1960, flood. Major floods are known to have occurred in 1931, 1936, 1945, 1952, 1956, 1960, and 1961. The largest floods of this group are those of May 20, 1936, and September 6, 1960. Current-meter measurements of Rio Guayanes made at Highway PR-3 define the stage-discharge relation from 30 to 1,200 cfs. The U.S. Soil Conservation Service has estimated the discharge of the 1960 flood at the valley cross section along Highway PR-3 to be 40,000 cfs. The area of inundation that resulted from floodflow in the lower Rio Guayanes basin is delineated on the topographic map. (Knapp-USGS) W71-08337

FLOODS IN CHANNAHON QUADRANGLE

FLOODS IN CHANNAHON QUADRANGLE NORTHEASTERN ILLINOIS, Geological Survey, Washington, D.C. Howard E. Allen, and Allen W. Noehre. For sale by US Geological Survey, Washington, DC, 20242, Price \$1.00. Geological Survey Hydrologic Investigations Atlas HA-362, 1 sheet, 1971. Text, 10 fig, 1 map, 2 tab, 4 ref.

Descriptors: \*Floods, \*Illinois, Maps, Profiles, Mapping, Flood forecasting, Frequency analysis, Stage-discharge relations, Data collections, Hydrologic data, Runoff. Identifiers: Channahon (III).

This 1-sheet hydrologic atlas presents hydrologic data that can be used to evaluate the extent, depth, and frequency of flooding that affect the economic development of flood plains in the Channahon quadrangle, northeastern Illinois. It will aid individuals, government agencies, and others responsible for solving existing flood problems and for for mulating effective flood-plain regulations that will minimize the creation of new flood problems. The report will also be useful for preparing building and zoning regulations, locating waste disposal facili-ties, developing recreational areas, and managing surface water in relation to groundwater resources. The areas inundated by floods along streams in the Channahon 7 1/2-minute quadrangle are delineated on a topographic map. Local residents reported that the flood of July 1957 was the highest observed in the past 50 years on Jackson Creek.
This flood had a 40-year recurrence interval at the Ims flood had a 40-year recurrence interval at the Du Page River gaging station. Profiles of the water surface, based primarily on elevations of marks left by the floods of October 1954, July 1957, and May 1966 are shown. Depth of flooding at any point can be estimated by subtracting the ground elevation from the water-surface elevation at the same point, indicated by the profiles. (Knapp-USGS) W71-08338

# INTERNATIONAL HYDROLOGICAL DECADE YEARBOOK OF THE FEDERAL REPUBLIC OF GERMANY-CALENDAR YEAR 1967.

Federal Republic of Germany 1967 International Hydrological Decade Yearbook, Coblenz, 1970. 138 p, 72 ref.

Descriptors: \*International hydrological decade, \*Hydrologic data, \*Data collections, \*Reviews, \*Hydrologic data, \*Data collections, \*Reviews, Surface waters, Stream gages, Groundwater, Water quality, Water yield, Streamflow, Runoff, Water levels, Hydrogeology, Soil moisture, Meterological data, Sediment transport, Water temperature, Water pollution, Evaporation, Water balance. Identifiers: \*Index (Hydrologic data), \*IHD Yearbook, \*Federal Republic of Germany.

This International Hydrological Decade yearbook contains information concerning hydrologic data collected in the Federal Republic of Germany during 1967. The local section of the contains the cont ing 1967. The location, description, and index of ing 1967. The location, description, and index of data collection stations along with related information are presented for the following programs: (1) Water Stage, Discharge, Suspended Matter Load, Dissolved Load and Temperature of River Waters; (2) Chemistry and Biology of River Waters; (3) Radioactivity of River Waters; (4) Groundwater Level; (5) Soil Moisture, Evaporation and Infiltration; and (6) Meteorological Data. (Woodard-W71-08346

MATHEMATICAL MODELS OF STREAM-FLOW TRANSFORMATION AND METHODS OF DETERMINING THEIR PARAMETERS. (RUSSIAN: MATEMATICHESKIYE MODELI PROTESSA TRANSFORMATSII RECHNOGO STOKA I METODY OPREDELENIYA IKH PARAMETROV), For primary bibliographic entry see Field 02E. W71-08373

# NUMERICAL SIMULATION OF WATERSHED

HYDROLOGY,
Texas Univ., Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W71-08392

WATER RESOURCE SYSTEM OPTIMIZATION BY GEOMETRIC PROGRAMMING, Texas A and M Univ., College Station. For primary bibliographic entry see Field 06A. W71-08393

SURFACE WATER **DATA--ATLANTIC** PROVINCES, 1968.

Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.

Canada Department of Energy, Mines and Resources, Inland Waters Branch Water Survey of Canada Report, 1971. 152 p.

Descriptors: \*Streamflow, \*Hydrologic data, \*Data collections, \*Stream gages, \*Flow rates, Gaging stations, Flow measurement, Average flow, Low flow, Peak discharge, Discharge measurement, Runoff.

Identifiers: \*Canada, Atlantic Provinces (Canada).

Streamflow data are presented for 158 sites in Newfoundland and Labrador, New Brunswick, Nova Scotia, and Prince Edward Island for the period October 1967 to December 1968. The tables of data include a description of the gaging station and daily, monthly, and yearly discharges of the stream. The description of the station gives the location, drainage area, extremes of discharge and general remarks. This report is one of a series containing hydrometric survey data for the Atlantic Provinces of Canada. (Woodard-USGS) W71-08524

# WATER RESOURCES OF THE RIVER ROUGE BASIN, SOUTHEASTERN MICHIGAN,

Geological Survey, Washington, DC R. L. Knutilla.

For sale by US Geological Survey, Washington, DC 20242 - price \$1.50 per set. Geological Survey Hydrologic Investigations Atlas HA-356, 2 sheets, 1971. Text, 19 fig, 7 map, 2 tab.

### Field 07—RESOURCES DATA

# Group 7C—Evaluation, Processing and Publication

Descriptors: \*Water resources development, \*Michigan, Streamflow, Groundwater, Water quality, Urbanization, Water pollution, Cities, Water yield, Runoff, Hydrologic data, Data collections, Maps, Surveys, Lakes.
Identifiers: \*Detroit (Mich), \*River Rouge (Mich).

This 2-sheet hydrologic atlas represents a part of a This 2-sheet hydrologic atlas represents a part of a comprehensive study of the water resources of southeastern Michigan. Its purpose is to provide information on (1) the physical features of the River Rouge and its tributaries, (2) the characteristics of streamflow, (3) the quality of ground and surface water, and (4) the availability of the groundwater. The River Rouge basin, a triangular area of 467 square miles, is characterized by hilly or moderatesquare miles, is characterized by hilly or moderately undulating topography in the north and west and by relatively flat land to the southeast. Larger streams in the basin flow through well defined valleys having gradually sloping banks which are from 20 to 30 feet above the valley floor. In areas of intensive urbanization natural drainage patterns have been altered by ditches and drains constructed of storm sewers. There are 404 lakes and prouds in the storm sewers. There are 404 lakes and ponds in the basin ranging in size from less than an acre to the 670 acres in Walled Lake. The River Rouge basin lies within the Detroit Metropolitan area and, except for isolated areas, the basin has been ur-banized. In much of the basin population densities are among the highest in the state. In the River Rouge basin water is relatively uniform in quality and, except for that obtained from bedrock, is chemically suitable for most municipal, agricultural and industrial supplies. Small to moderate quanti-ties of water are available nearly everywhere in the ties of water are available nearly everywhere in the River Rouge basin from wells completed in the gla-cial drift or bedrock aquifers. Wells drilled in bedrock usually yield water that is too highly mineralized for most uses. (Knapp-USGS) W71-08535

# FLOODS IN THE ANASCO AREA, PUERTO

Geological Survey, Washington, D.C.
Fred K. Fields.
For sale by US Geological Survey, Washington, DC
20242-price 75 cents. Geological Survey Hydrologic Investigations Atlas HA-375, 1 sheet, 1971.
Text, 6 fig, 1 map, 2 tab.

Descriptors: \*Floods, \*Puerto Rico, Maps, Profiles, Mapping, Flood forecasting, Frequency analysis, Stage-discharge relations, Data collections, Hydrologic data, Runoff. Identifiers: Anasco (Puerto Rico).

This 1-sheet hydrologic atlas provides factual and interpretive information to be used by the planner, designer, or any interested person, to reach more rational decisions related to land use in the flood plain of the lower reaches of Rio Grande de Anasco, Puerto Rico. Among the data presented are tabulations of flood stages, stream-flood profiles, and area of inundation for the flood of September 13, 1928, on Rio Grande de Anasco. and the area inundated in the vicinity of Anasco by floodwaters of Rio Daguey on August 12, 1956. Stage-frequency curves are presented from which the magnitude of future floods of selected recurrence interval can be estimated. Areas of inundation and flood profiles are specifically for valley conditions that existed at the time of the floods. The flood plain of the lower Rio Grande de Anasco has been inundated extensively at least four times during the period 1899-1967. The greatest flood known occurred August 8, 1899. The second greatest flood was that of September 13,1928. Other major floods occurred on September 26, 1932, and September 23, 1952. The peak discharge of the 1928 flood on Rio Grande de Anasco was computed as 35,000 cfs on the basis of the highwater profile and the channel geometry in the vicinity of El Espino. The inundated area was defined on the basis of flood-stage information furnished by local residents. The estimated water-surface contours for the flood of September 13, 1928, are shown on the topographic map. (Knapp-USGS) W71-08536

WATER QUALITY INFORMATION SYSTEMS, THE KEY TO CLEANER WATERS, Pennsylvania Dept. of Health, Harrisburg. Bureau

of Sanitary Engineering.
For primary bibliographic entry see Field 05A. W71-08551

COORDINATION - THE KEY TO EFFECTIVE WATER DATA MANAGEMENT, Geological Survey, Washington, D.C. Office of Water Data Coordination.

For primary bibliographic entry see Field 05A. W71-08552

BASIC DATA REQUIREMENTS TO EVALUATE WATER POLLUTION IN QUALITY CONTROL PROGRAMS, NUS Corp., Pittsburgh, Pa. Cyrus William Rice

For primary bibliographic entry see Field 05A. W71-08553

LESSONS TO BE LEARNED WHEN COLLECT-ING VALID DATA,

Manhattan Coll., Bronx, N.Y. Dept. of Civil Enor primary bibliographic entry see Field 05A.

FORECASTING OF WATER QUALITY DATA IN THE DELAWARE RIVER ESTUARY, Delaware River Basin Commission, Trenton, N.J. For primary bibliographic entry see Field 05A.

NEED FOR WATER QUALITY DATA IN PLANNING WATER RESOURCE DEVELOP-MENTS,

Geological Survey, Lincoln, Nebr. Water Resources Div.

For primary bibliographic entry see Field 05A. W71-08558

PROJECT HYDRA,

W7 i-08555

For primary bibliographic entry see Field 07B. W71-08614

ERRORS TO AVOID IN WATER QUALITY COLLECTION AND SAMPLING, Bureau of Reclamation, Sacramento, Calif.

For primary bibliographic entry see Field 05A.

ERRORS TO AVOID IN COLLECTION AND SAMPLING,

Interstate Sanitation Commission, New York. For primary bibliographic entry see Field 05A. W71-08879

ON THE ANALYSIS AND USE OF WATER QUALITY DATA,

Kansas State Univ., Manhattan. Dept. of Chemical

Engineering.
For primary bibliographic entry see Field 05A.
W71-08882

MINICOMPUTERS AND WATER QUALITY SURVEILLANCE, Minneapolis-St. Paul Sanitary District, St. Paul,

For primary bibliographic entry see Field 05A. W71-08888

THE WATER MANAGEMENT INFORMATION SYSTEM (WAMIS),

Spindletop Research, Inc., Lexington, Ky. For primary bibliographic entry see Field 05A. W71-08889

EXPERIENCE WITH COMPUTER USE IN MANAGING WATER QUALITY DATA IN THE DELAWARE RIVER BASIN, Geological Survey, Philadelphia, Pa. For primary bibliographic entry see Field 05A.

BENEFICIAL USES AND PITFALLS OF HISTORICAL WATER-QUALITY DATA, Geological Survey, Washington, D.C. For primary bibliographic entry see Field 05A. W71-08891

HYDROLOGIC DATA UTILIZATION IN FORECASTING THE SPRING 1969 MIDWEST

SNOWMELT FLOODS, Environmental Science Services Administration, Kansas City, Mo., Weather Bureau River Forecast

For primary bibliographic entry see Field 02E. W71-08893

COMPUTERIZED **PROGRAMS** WATER MANAGEMENT MICHIGAN'S

Michigan Water Resources Commission, Lansing; and Ernst and Ernst, Detroit, Mich. For primary bibliographic entry see Field 05A. W71-08894

ANNUAL COMPILATION AND ANALYSIS OF HYDROLOGIC DATA FOR ESCONDIDO CREEK, SAN ANTONIO RIVER BASIN, TEXAS--1969,

Geological Survey, Austin, Tex. D. R. Reddy.

Geological Survey Data Report, Feb 1971, 62 p, 2 fig, 3 tab.

Descriptors: \*Streamflow, \*Rainfall-runoff rela-\*Texas, Small watersheds, Flow measurements, Stream gages, Flow characteristics, Flow rates, Hydrographs, Mass curves, Floods, Watershed measurement.

Identifiers: \*Runoff computations, \*Escondido Creek (Tex), Water budget, Flood-retarding struc-

This report, which is the ninth in a series of basicdata reports published annually for the Escondido Creek study area, contains the rainfall, runoff, and storage data collected during the 1969 water year (Oct. 1968 - Sept. 1969) for the 72.4-square-mile area above stream-gaging station Escondido Creek at Kenedy, Texas. The location of floodwater-retarding structures and hydrologic instruments in tarding structures and hydrologic instruments in the area are shown. The mean annual rainfall (1931-60) at Karnes City is 31.93 inches. The weighted-mean rainfall over the study area for the 1969 water year was 28.31 inches, or 97 percent of the 15-year average of 29.06 inches. Monthly rainfall ranged from 0.39 inch in December to 3.94 inches in April. Mean daily discharge at the stream-gaging station was 12.1 cfs, compared with the 15year average of 14.3 cfs. Annual runoff at the stream-gaging station was 8,760 acre-feet, or 2.27 inches. For the 1969 water year four storms were selected for detailed computations. These computations include detailed time breakdown of rainfall and discharge. Hydrographs and mass curves are drawn for illustrations. (Woodard-USGS) W71-08903

ANNUAL COMPILATION AND ANALYSIS OF HYDROLOGIC DATA FOR GREEN CREEK, BRAZOS RIVER BASIN, TEXAS--1969,

Geological Survey, Austin, Tex.

B. C. Massey.

Geological Survey Data Report, 1970. 44 p, 2 fig, 3

Descriptors: \*Streamflow, \*Rainfall-runoff relationships, \*Data collections, \*Hydrologic data, \*Texas, Small watersheds, Flow measurements, Flow characteristics, Flow rates, Hydrographs, Mass curves, Stream gages, Rain gages, Floods, Peak discharge, Watershed management. Identifiers: \*Runoff computations, \*Green Creek (Tex), Water budget, Flood-retarding structures.

This report which is the tenth in a series of basicdata report which is the tenth in a series of basic-data reports published annually for the Green Creek study area, contains the rainfall, runoff, and storage data collected during the 1969 water year (Oct. 1968 - Sept. 1969) for the 46.1-square-mile area above the stream-gaging station Green Creek near Alexander, Texas. The locations of the flood-water retarding structures and hydrologic instruwater-retarding structures and hydrologic instru-ments in the area are shown. The weighted-mean ments in the area are shown. The weighted-mean rainfall was 31.01 inches, or 98 percent of the 1931-60 long-term mean annual rainfall of 31.67 inches in Dublin, Texas. The mean daily discharge at the stream-gaging station Green Creek near Alexander was 12.7 cfs compared with the 11-year (1958-69) average of 6.14 cfs. Three storm periods (1958-69) average of 6.14 cfs. Three storm periods were selected for detailed analysis and computation. These computations include detailed time breakdown of rainfall and discharge, hydrographs, and mass curves. The storms selected occurred on April 12, 1969, May 6-7, 1969, and July 27, 1969. A summary of rainfall-runoff data for these storms is tabulated. Computations along the hydrographs and mass curves for the storms are shown in the and mass curves for the storms are shown in the compilation and analysis of data. (Woodard-USGS) W71-08918

# SELECTED GROUNDWATER DATA IN THE EUGENE-SPRINGFIELD AREA, SOUTHERN WILLAMETTE VALLEY, OREGON,

WILLAMETTE VALLET, OREGON,
Geological Survey, Portland, Oreg.
J. F. Frank, and Nyra A. Johnson.
Oregon State Engineer Groundwater Report No
14, Oct 1970. 70 p, 5 fig, 1 plate, 4 tab, 8 ref.

Descriptors: \*Hydrologic data, \*Oregon, \*Hydrogeology, \*Aquifers, \*Water resources development, Groundwater, Data collections, Water wells, Aquifer characteristics, Water yield,

Water quality. Identifiers: \*Eugene (Oreg), \*Springfield (Oreg).

The cities of Eugene and Springfield, Oregon, and their outlying districts consistute an area where, because of a rapidly growing population, progressively greater volumes of groundwater are being required for industrial, irrigation, and public supplies. Because of different geologic and hydrologic conditions in the area, the occurrence, quality, and availability of groundwater vary considerably from availability of groundwater vary considerably from place to place. The most productive groundwater reservoirs in the Eugene-Springfield area are related to the alluvial deposits (sand and gravel) of the McKenzie and Willamette Rivers; consequently, the high-yield wells are on or adjacent to the valley plain that is underlain by the alluvial deposits. The water table in the alluvial aquifers is generally only a few feet below land surface. Pump generally only a few feet below land surface. Pumping lifts are relatively small, and large-diameter wells produce moderate to large quantities of groundwater of good chemical quality. (Knapp-USGS) W71-08921

CATALOG OF INFORMATION ON WATER DATA, EDITION 1970 - INDEX TO AREAL INVESTIGATIONS AND MISCELLANEOUS WATER DATA ACTIVITIES.
Geological Survey, Washington, D. C. Office of Water Data Coordination.

Available on application to the U.S. Geological Survey, Washington, D.C. 20242. Geological Survey Water Data Catalog, 1971. 178 p, 2 exhibits, 2

Descriptors: \*Data storage and retrieval, \*Hydrologic data, \*Data collections, \*Reviews, \*Publications, Unites States, Documentation, Areal, Surface waters, Groundwater, Water resources, Federal government, State governments, Investigations.

Identifiers: \*Index, \*Areal investigations, Hydrologic data aquisition, Canada.

This index, for use in retrieving water data for the U. S. contains (1) the title of each investigation, (2) the geographic area covered, (3) the inclusive dates of the investigation, (4) description of the investigation, (5) whether or not a report will be published, and (6) the reporting agency. This index, which reflects activities as of January 1, 1970, is the second edition of this section of the Catalog. The first edition was the 1968 edition. The Catalog is a file of information about water-data-acquisition activities. This file is on media suitable for data processing, supplemented by microforms and staprocessing, supplemented by microforms and sta-tion-location maps. The information contained in the Catalog file is reported on OWDC on standard forms by Federal State, municipal agencies, and private organization that acquire water data directly in the field and laboratory. Thus, the Catalog is a file of information about water-data-acquisition activities and does not access. catalog is a file of information about water-data-acquisition activities and does not contain the ac-tual data, which must be obtained from the report-ing agencies. (Woodard-USGS) W71-08922

# RECONNAISSANCE OF THE BLACK RIVER, A COLD-WATER RIVER IN THE NORTH-CENTRAL PART OF MICHIGAN'S SOUTHERN PENINSULA,

Geological Survey, Washington, D.C. Geological Survey, Washington, D.C. G. E. Hendrickson, and C. J. Doonan. For sale by the U.S. Geological Survey, Washington, D.C.--Price \$1.25 per set. Geological Survey Hydrological Investigations Atlas HA-345, 1971. 2 sheets, Text, 3 fig, 5 map, 7 tab, 11 ref.

\*Michigan, \*Pescriptors: \*Rivers, \*Michigan, \*Fishing, \*Recreation, Water quality, Streamflow, Velocity, Wild rivers, Scenery, Water resources development, Maps, Hydrologic data. Identifiers: \*Black River (Mich). \*Rivers.

The Black River north of Johannesburg in Otsego County has been rated by many fisherman as the number one brook-trout stream in the north-central part of the southern peninsula of Michigan. Headwaters are a few miles north of Johannesburg, and the Black River flows northward to join the Cheboygan River a few miles south of Cheboygan. The recreational value of a river depends on the characteristics of streamflow, water-quality, and its bed and banks. The purpose of this atlas is to describe these characteristics and to show how they relate to recreational uses. Sheet 1 of this atlas presents information on streamflow characteristics and water quality. Sheet 2 describes the physical character of the stream channel, bed and banks, and shows how it relates to streamflow, water quality, and recreational use. (Knapp-USGS) W71-08925

# RECONNAISSANCE OF THE STURGEON RIVER, A COLD-WATER RIVER IN THE NORTH-CENTRAL PART OF MICHIGAN'S SOUTHERN PENINSULA,

Geological Survey, Washington, D.C. G. E. Handrickson, and C. J. Doonan. For sale by U.S. Geological Survey, Washington, D.C. - Price \$1.25 per set. Geological Survey Hydrologic Investigations Atlas HA-353, 1971. 2 sheets, Text, 11 fig, 5 map, 5 tab, 14 ref.

\*Michigan, \*Rivers, \*Recreation, Water quality, Streamflow, Velocity, Wild rivers, Scenery, Water resources development, Maps, Hydrologic data. Identifiers: \*Sturgeon River (Mich).

The Sturgeon River, one of the best brown trout streams in Michigan, is located in the north-central part of the southern peninsula of Michigan with headwaters just north of Gaylord. The purpose of this 2-sheet hydrologic atlas is to describe these characteristics and to show how they relate to recreational uses. Sheet 1 of this atlas presents information on streamflow characteristics and water quality. Sheet 2 describes the physical charac-

teristics of the stream channel and bed and banks, and shows how these physical characteristics relate to streamflow, water quality, and recreational use. (Knapp-USGS) W71-08926

### HYDROLOGIC DATA: 1968, VOLUME 4, SAN JOAQUIN VALLEY.

California State Dept. of Water Resources, Sacra-

Copies of report available from Office of Procurement, Documents Section, P. O. Box 20191, Sacramento, Calif. 95820-Price \$4.00. California Department of Water Resources Bulletin No 130-68, October 1969. 222 p, 7 fig, 4 plate, 26 tab, 5 ap-

Descriptors: \*Hydrologic data, \*Surface waters, \*Groundwater, \*California, Water resources development, Data collections, Water levels, Streamflow, Water quality, Monitoring, Water wells, Aquifers, Stream gages, Climatology. Identifiers: \*San Joaquin Valley (Calif).

Report contains tables showing data on climate, surface water flow, groundwater levels, and surface and groundwater quality in the San Joaquin Valley for the 1967-68 water year. Figures show location of climatological, surface water, and surface water quality measurement stations; fluctuation of water levels in selected wells and areas; and electrical conductance at selected stations. Plates show lines of equal elevation of water in wells, spring 1968; profile of groundwater levels; cooperative study areas; groundwater level changes; and well locations. (Knapp-USGS)
W71-08927

# NATIONAL REFERENCE LIST OF WATER QUALITY STATIONS-WATER YEAR 1971. Geological Survey, Washington, D. C. Water

Resources Div.

For primary bibliographic entry see Field 05A. W71-08937

### SURFACE WATER SYSTEM - OPERATIONAL HANDBOOK.

Wyoming Univ, Laramic. William N. Embree.

Wyoming Water Resources Research Institute Water Resources Series No. 18, July, 1970, 84p.

Descriptors: \*Computer programs, Data storage and retrieval, \*Hydrologic data, Streamflow, \*Data collections, Data processing.

The Surface Water System, developed by Wyoming Water Resources Research Institute, provides for easy and effective streamflow data processing. Daily streamflow data are stored on magnetic tape, and are processed and maintained through a separate program tape and card-oriented instructions. Complete description of all processing and maintenance instructions, as well as detailed examples of their use, are given. W71-08941

# 08. ENGINEERING WORKS

### 8A. Structures

THE WELL DRILLER AND THE GROUND-WATER HYDROLOGIST, COMPETITORS OR ALLIES,

R. C. Smith. Water Well Journal, Vol 13, No 7. 3 p.

Descriptors: \*Water wells, Drilling, Drilling equipment, Groundwater, Water supply, Wells.

Building and maintaining a complete underground water supply without a complete hydrological sur-

### Field 08-ENGINEERING WORKS

### **Group 8A—Structures**

vey can be like building a complete water system without a consulting engineer or a large building without an architect. In this day of growing water demands, of increasing conflicts between users of individual demands for quantities that were almost unknown not too many years ago, groundwater is an extremely valuable resource. We must use, develop and manage our vast groundwater supplies to the fullest extent and in the most efficient manner. This is the aim of the water well contractor. It is also the aim of the groundwater hydrologist. This paper attempts to bridge the 'trust gap.' (Campbell-NWWA) W71-08408

### METHODS OF SETTING AND PULLING JOHN-SON WELL SCREENS.

Universal Oil Products Co., St. Paul, Minn. John-

UOP Johnson Division Bulletin No 933 (Revised Feb 1957). 16 p, 20 fig, 2 tab.

Descriptors: \*Water wells, \*Screens, Rotary drilling, Drilling equipment, Acid, \*Well screens,

Identifiers: Cable tool drilling.

Where conditions permit its use, the simplest and best method of setting screens is called the 'stan-dard' or pull-back method. The only requirement for this method of installation is that the casing must be of such kind and in such condition that it can be sunk down to the point where the bottom of the screen is to be set and then pulled back the length of the screen. When a screen cannot be set by the 'standard' method and the necessity arises for setting it by bailing or washing it down with open bottom, there are several other methods which may be employed, all of which center around the 'bail-down' method. The principles upon which all bailing-down processes are based is that by maintaining a constant weight on the screen and removing the sand and gravel which lies directly below the bottom of the screen, the screen will settle down by force of gravity to take the place of the material which is withdrawn. The two essentials are, therefore, provision of proper weight upon the screen, and a means whereby the material beneath the screen may either be removed or displaced so that the screen can settle down through the waterbearing formation. The various problems encountered during installation are discussed in some detail. (Campbell-NWWA) W71-08468

# GRAVEL PACKING CONTROLS UNCON-SOLIDATED SAND IN VENEZUELA FIELD,

Creole Petroleum Corp., Lagunillas (Venezuela). P. S. McReynolds.

Journal Petroleum Technology, Vol 10, No 12, p 21-24 Dec, 1958. 2 fig, 5 ref.

Descriptors: Oil industry, \*Gravel, Screens, Sands, \*Well casings, Casings, \*Oil wells. Identifiers: Gravel packing, Unconsolidated sand,

Venezuela, Completion methods, \*Sand control,

Sand control has been the major problem encountered in producing oil from the unconsolitated Miocene sands in the Lagunillas area of Venezuela. One of the first completions developed to prevent excessive sand production was the combination oil string in which pre-perforated casing was em-ployed. In most cases this method was unsuccessful in controlling sand and was replaced in 1951 by a special slotted liner completion. The slotted liner technique has been effected in controlling sand and in obtaining high volume producers in the Bachaquero sand member. However, as a satisfactory completion depends upon the ability to wash well into production outside the liner, this technique will soon become obsolete because of the declining reservoir pressure in the Bachaquero field. A program to evaluate gravel packing as a replacement for the slotted liner technique and to

provide a sand control method for use inside existing pre-perforated completions was initiated in April, 1956. Forty-three wells have been gravel packed in the Lagunillas Dist. through Sept. 25, 1957, with two jobs considered as failures. Eight wells are awaiting installation of production equipment and are expected to be satisfactory producers when opened to production. Various problems concerning fluids, liner slot sizes and loss of gravel to the formation have been encountered. Solutions to these problems have been found and procedures for both open-hole and inside gravel packs have been developed that can be applied with con-fidence to the sand control problems that exist in the Bolivar coastal fields. (Campbell-NWWA)

### SAFE WAY TO CLEAR PLUGGED BITS,

Companhia de Petroleos de Angola. F. A. M. DaSilva.

World Oil, Vol 161, No 2, p 114 and 118, Aug

Descriptors: \*Drilling, \*Oil industry, Drilling equipment, Drilling fluid, \*Mud, Mud-water inter-

Identifiers: Mud densities, Annular mud velocity, Reverse mud circulation, Plugged bit.

Plugged bits are common problems in the drilling industry. Bits usually are plugged inside by cuttings, mud cake or sand. This can be caused by differences in mud densities (higher in annulus than in the drill pipe) when a connection is made. Mud flows back into the drill string and some cuttings, mud cake or sand enter through bit nozzles. After the connection is made, the pump is started, causing an abrupt increase of pressure which compacts the cuttings in the bit. Many times, it is impossible to resume circulation. A safe solution to the problem lies in progressively increasing the pressure differential at the bit. (Campbell-NWWA) W71-08505

# SPILLWAY FOR BELLEVILLE LOCKS AND DAM, OHIO RIVER, OHIO AND WEST VIRGINIA. HYDRAULIC MODEL INVESTIGA-

TION,
Army Engineer Waterways Experiment Station,
Vicksburg, Miss.
G. A. Pickering.

Available from the National Technical Information Service as AD-719 170, \$3.00 in paper copy, \$0.95 in microfiche. WES Technical Report 2-687, Aug 1965, 10 p.

Descriptors: \*Dams, \*Model studies, \*Flow, \*Test procedures, Spillways, Stilling basins, Riprap. Identifiers: Belleville Dam.

The spillway at Belleville Dam will consist of eight 110-ft-wide bays through which flow will be regulated by tainter gates. Energy dissipation will be accomplished on a horizontal apron with baffle piers and an end sill. Model investigations were conducted on a 1:36-scale section model which reproduced one central gate bay and approximately half of each adjacent gate bay. Tests were con-cerned with gate sill shape, stilling basin per-formance, and riprap requirements downstream from the stilling basin. Tests revealed that flow conditions were satisfactory for all partial gate openings with the original design gate sill shape. The original design stilling basin resulted in high bottom velocities in the exit channel which were reduced by lowering the elevation of the basin apron. The stability of a stone protection blanket placed on a 1-on-6 slope downstream from the end sill was determined. W71-08512

### BREAKER TRAVEL AND CHOICE OF DESIGN WAVE HEIGHT,

Army Coastal Engineering Research Center, Washington, D.C. For primary bibliographic entry see Field 08B. W71-08528

### AUBURN DAM WILL BE THE WORLD'S LON-GEST CONCRETE ARCH DAM,

Bureau of Reclamation, Denver, Colo. B. P. Bellport.

World Dams Today, p 343-347, 1970. 5 p, 6 fig.

Descriptors: Dams, \*Concrete dams, \*Arch dams, Thin arch dams, Bridges (Structures), Large structure, \*Double-curvature arch dams, Dam design, Dam foundations, Foundation investigations, Hydroelectric powerplants, Geologic investigations, Spillways, Environmental effects, Outlet works works.

Identifiers: \*Auburn Dam (Calif), Superlative, Central Valley Project, Bureau of Reclamation.

Auburn Dam will be the principal structure of the Bureau of Reclamation's Auburn-Folsom South Unit of the Central Valley Project in California. The dam will be a double-curvature, thin-arch structure, 4,000 ft long, 685 ft high, and will have a volume of 6,000,000 cu yd of concrete, a crest width of 40 ft, and a maximum base width of 200 ft. Major features of the dam, including the power-plant, outlet works, spillways, elevated highway crossing on the crest of the dam, and a bridge that will cross an arm of the reservoir, are described. A feature new to Bureau of Reclamation design is a pad of concrete to be placed as an integral part of the dam throughout the profile of the damsite between the arch and abutment rock. The pad will improve the symmetry of the arches and reduce the load intensity between the arch section and abutments by distributing the pressure more uniformly on the foundation. Extensive foundation investigations and tests were made because of the size of the dam and the complexity of the geological formation at the damsite. (USBR)
W71-08622

#### STABILITY OF COLUMNS WITH TRANSIENT LOADS.

Illinois Univ., Urbana.

S. M. Holzer.

Proceedings, American Society of Civil Engineers, Journal of Engineering Mechanics Division, Vol 96, No EM6, p 913-930, Dec, 1970. 18 p, 4 fig, 1 tab, 9 ref, 3 append.

\*Stability Descriptors: \*Stability analysis, \*Columns, Transient stress, \*Dynamic loads, Amplification, Dynamic stability, \*Structural analysis, Dynamic \*Columns, Pynamic stability, Structural analysis, Dynamic response, Structural stability, Loads (Forces), Structural engineering, Structural members, Differential equations, Displacements, Deflection, Motion, Analytical techniques.

Identifiers: Equations of motion, Perturbation, \*Liapunov theorem.

The transverse motion of elastic columns with general end fixity subject to transient loading is described by an integro-differential equation reduced to a set of ordinary differential equations. Liapunov's direct method of the general problem of stability of motion is employed to ascertain stability directly from the differential equations of mo-tion without knowledge of the solution. For the special case of simply supported columns, a Liapunov function is constructed, and a stability criterion is deduced from the characteristics of the function. The stability criterion constitutes a relation between a bound on the amplification of the initial perturbation and the corresponding force pulse; the relation is obtained in explicit form. Application of the stability criterion is shown for 3 sample loadings: a trigonometric pulse, a parabolic pulse, and a step pulse. The amplification bound is evaluated through comparison with the trajectory of maximum response of the governing differential equations of motion. Use of the criterion is a simple and quick method for the stability analysis of simply supported columns. W71-08644

# WATER WELL ENGINEERING, MORE ON WELL DESIGN CRITERIA,

Bureau of Reclamation, Denver, Colo. T. P. Ahrens.

### Hydraulics—Group 8B

Water Well Journal, Vol 12, No 11 and 12, Nov and Dec 1958. 8 p, 7 fig.

Descriptors: \*Water wells, \*Drilling, Rotary drilling, Drilling equipment, Drilling fluids, Screens, Cement, Casings.
Identifiers: \*Artesian aquifer, \*Unconfined aquifer, \*Well design criteria, Sample descriptions, Well development, Pump tests, Specific yield.

Mathematically sound and physically correct theoretical equations have been developed which theoretical equations have been developed which presumably may be used to analyze nearly any combination of aquifer characteristics and well design. However, all of the equations assume a knowledge of and a uniformity of conditions and an accuracy of measurement which are virtually impossible to realize. Indeterminate errors are consequently inevitable. Investigations or tests to possible to realize. Indeterminate errors are consequently inevitable. Investigations or tests to eliminate the errors are neither physically nor economically feasible. Nevertheless, the formulas and equations are basic to good well design. Of equal importance is judgment based on experience which permits an estimate of the influence of the undestrained errors. undetermined errors. Because of our dependence on judgment, there is probably a tendency to over-design on important well installations. It is doubtful if this can ever be fully overcome, but it can be reduced, and limited by further research and the exchange of ideas and developments. (Campbell-NWWA) W71-08666

CEMENTING SMALL WELLS,
Miller (J. P.) Artesian Well Co., Brookfield, Ill.
W. A. McEllhiney. Water Well Journal, Vol 9, Nos 1 and 2, Jan and Feb 1955. 5 p, 10 fig.

Descriptors: \*Water wells, \*Drilling, \*Cement, Drilling equipment.
Identifiers: \*Cementing, Cementing pipe string,
Pressure - grouted liner, Portland cement, Cement-

This paper treats water well cementing techniques in practical detail. The author is well known in the field for his outstanding knowledge and experience in water well construction techniques. It is well il-lustrated and has considerable emphasis on the sanitary aspects of well construction. (Campbell-NWWA) W71-08667

HOW TO COMPLETE WATER SOURCE WELLS.

Marathon Oil Co., Regina (Saskatchewan). M. D. Todd. World Oil, Vol 164, No 4, p 86-91, Mar 1967. 2 fig,

Descriptors: \*Water wells, \*Oil industry, Gravels, Identifiers: \*Gravel packing, Selection of gravel material, Saskatchewan, Deep well difficulties

Carefully planned and executed completion procedures developed especially for water source wells have provided an adequate, reliable and economical supply of water for three major Canadian fluid injection projects. Modified and simplified gravel packing techniques are primarily responsible for sand-free water production at rates to 4,000 bpd per well. Although developed for use in specific types of wells in one area, it is felt that many of the methods that have proved successful-can be applied to water source wells anywhere. This article discusses the experience-derived gravel packing techniques and other related completion packing reciniques and other related completion practices perfected by Marathon Oil Co. for its water source wells in Southwestern Saskatchewan. (Campbell-NWWA) W71-08830

THE ROLE OF THE DRILLING CONTRACTOR OVERSEAS AS SEEN BY THE OPERATOR, Amoco International Oil Co., Chicago, Ill.

For primary bibliographic entry see Field 06A. W71-08841

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN NEW YORK.

Corps of Engineers, New York. North Atlantic Div. For primary bibliographic entry see Field 04A. W71-08902

WELL DESIGN CRITERIA,

Bureau of Reclamation, Denver, Colo. T. P. Ahrens

Water Well Journal, Vol. 11, Nos. 9 and 11, 8 p., September and November, 1957, 4 fig., 1 ref.

Descriptors: \*Water wells, \*Drilling, Rotary drilling, Drilling equipment, Drilling fluids, Screens, Cement, Casing.

Identifiers: \*Well design criteria, Sample analyses, Selection and design of packs, Pack materials, Screen slot size, Well development.

This paper outlines some of the procedures and well design criteria developed or adopted and used by the Office of Drainage and Ground water Engineering of the Bureau of Reclamation in Denver. It deals principally with irrigation wells, but much It deals principally with irrigation wells, but much of the criteria are applicable to domestic, industrial, and municipal water wells. The criteria generally do not apply to wells for ground water observations, ground water recharge, drainage, excavation de-watering, drilling water supply or for other temporary or special purposes. The Bureau drills wells in the 17 Western states and in some of the tearteries. Available drilling equipment and the territories. Available drilling equipment and materials, well construction methods, and local physical conditions vary widely over this large area. The aim of well design is always the best possible well for the purpose, taking into consideration the demand, required period of sustained pumping, effective life, initial investment, operation and maintenance costs, local regulations and practices, and normal precautions on sanitary construction and aquifer contamination. Accordingly, the objective is to design the most efficient and economical well for any given aquifer and purpose. (Campbell-NWWA) W71-08931

### 8B. Hydraulics

TRANSPORT AND DISPERSION OF FLUORESCENT TRACER PARTICLES FOR THE FLAT-BED CONDITION, RIO GRANDE CONVEYANCE CHANNEL, NEAR BERNARDO, NEW MEXICO,

Geological Survey, Washington, D.C. For primary bibliographic entry see Field 02J. W71-08328

CALCULATION OF FLOWS DURING SUDDEN FLOW EXPANSION (RUSSIAN: RASCHET TECHENIY PRI VNEZAPNOM RASSHIRENII POTOKA), Leningradskii Institut Inzhenerov Vodnogo Transporta Moscow (USSR).

A. N. Butakov. Meteorologiya i Gidrologiya, No 11, p 70-76, Nov 1970. 3 fig, 6 ref.

Descriptors: \*Flow measurement, \*Model studies, \*Non-uniform flow, \*Channel flow, Foreign research, Turbulent flow, Reynolds number, Viscosity, Roughness (Hydraulie), Friction, Eddies, Froude number. Identifiers: \*USSR, Reflux.

An attempt is made to calculate the velocity field during sudden nonuniform expansion of flow, taking into account tangential stresses of turbulent visosity and bottom friction. A model of a sharply expanding reach consisting of an inlet channel 5 m long and 0.5 m wide and terminating in a symmetrical, sharply expanding reach 7 m long and 3 m wide

is used. Depth of flow is 5.5 cm and the Reynolds and Froude numbers are 10,000 and 0.08, respectively. Kinematics of flow is studied for two bottom roughnesses: a smooth bottom and a bottom with a roughness in the form of 5-mm high staggered projections 1.5-2 cm apart. A comparison of experimental and theoretical data is made for coefficients of turbulent flow 0.04, 0.05, 0.06 and 0.08, and for a change in the friction coefficient ranging from 0.002 to 0.020. A good fit of design velocity curves with experimental curves is obtained for coefficient 0.04, irrespective of roughness, provided friction coefficients 0.0025 and 0.011 are assumed for the first and second series of experiments, respectively. Calculations performed for a suddenly expanding reach of limited width with friction coefficients 0.0000, 0.0010 and 0.0016 reveal that bottom roughness has a great effect on the length of an eddy zone and the reverse flow (reflux) rate. (Josefson-USGS) w71-08371

TRANSPORT PROCESSES OF PARTICLES IN DILUTE SUSPENSIONS IN TURBULENT WATER FLOW - PHASE I, Illinois Univ., Urbana. Water Resources Center.

Barclay G. Jones, James A. Beoletto, Charles C. Meek, Raymond J. Ostensen, and Ronald Robin. Meek, Raymond J. Ostensen, and Ronald Robin. Available from the National Technical Information Service as PB-199 710, \$3.00 in paper copy, \$0.95 in microfiche. Research Report No 40, Water Resources Center, University of Illinois, Urbana, Illinois, Mar, 1971. 36 p, 14 fig, 20 ref. OWRR Project A-019-ILL (2).

Descriptors: \*Water pollution sources, Flow measurements, \*Dispersion, \*Turbulent flow, Flow. Identifiers: \*Turbulent particulate transport, Dilute suspension, Non-Stokesian.

Modifications to an existing experimental system have been made and have been demonstrated to provide the required resolution and variable parameterization necessary for a detailed study of dilute particle suspensions in a turbulent water flow. These modifications together with the reasons for their experience are discovered in contrasting of for their necessity are discussed. Linearization of non-Stokesian drag has been accomplished through the introduction of a diagonal tensor into the stokes drag force equation. It was found that non-Stokesian effects tend to be of minor importance in the response of water borne particles. W71-08492

HYDRODYNAMICS AND DISCHARGE MEASUREMENTS OF STORM SEWERS, Rutgers - The State Univ., New Brunswick, N. J. Water Resources Research Inst. E. L. Bourodimos, and A. Oguntase.

Available from the National Technical Information

Available from the National Technical Information Service as PB-199 712, \$3.00 in paper copy, \$0.95 in microfiche. New Jersey Water Resources Research Institute, New Brunswick, Mar 1971, 13 p, 4 fig. OWRR Project A-028-N.J. (1).

Descriptors: \*Storm drains, \*Hydrodynamics, Storm runoff, Fluid mechanics, Flow, Hydraulics. Identifiers: \*Urban hydrology, Storm sewers.

This completion report was a first step in a study of flow in storm sewers. A critical review of a major protion of numerous theoretical and experimental research papers on gradually varied unsteady flows has been completed. The engineering relevance of these studies to storm sewer flow dynamics is evaluated for practical applications for storm runoff in urban areas. Lateral inflow dynamics (spatially varied flow) is now under consideration and study. This will conclude the first major phase of the program, i.e., the mathematical modelling and theoretical analysis. The next step will be the analytical study and modelling of diffusional processes in combination with such types of flows in storm sewers. The two other phases of the program are: i) field work and investigation, and ii) experimental laboratory study on a simplified sewer system model and comparison of theoretical pre-

### Field 08—ENGINEERING WORKS

### **Group 8B—Hydraulics**

dictions with field and laboratory data. (Whipple-Rutgers) W71-08496

LOCK FILLING AND EMPTYING SYSTEM, HOLT LOCK AND DAM, WARRIER RIVER, ALABAMA: HYDRAULIC MODEL INVESTIGA-

Army Engineer Waterways Experiment Station, Vicksburg, Miss.

T. E. Murphy, and J. H. Ables.

T. E. Murphy, and J. H. Ables. Available from the National Technical Information Service as AD-719 680, \$3.00 in paper copy, \$0.95 in microfiche. Technical Report No 2-698, Nov 1965. 127 p, 70 fig, 26 tab. Identifiers: \*Dams, \*Design, Drainage, Hydraulic models, Model tests, Alabama, Inland waterways, Fluid flow, Construction, \*Holt Lock and Dam, \*Warrior River, \*Locks, Waterways, Tuscaloosa, Alabama, Snillways. Alabama, Spillways.

A 1:25-scale model was used to confirm the adequacy of the proposed, floor lateral culverts, filling and emptying system. A 1:15-scale model of the reverse tainter culvert valve was used to determine loads and load variations on he valve hoisting mechanism and means of reducing these loads. The adopted filling and emptying system included 12 lateral culverts with 10 ports each, centered in the lock, alternating from the two longitudinal culverts, and covering about 28 percent of the chamber length. The lock can be filled in 11 min and emptied in 12.6 min with hawser stresses not exceeding 5 tons. A split-lateral system was also investigated. However, the interlaced system is preferable for single-culvert, or nonsynchronized valve operation. Two basic designs of the reverse tainter valve were investigated. In the adopted design the skin plate was separated from the main girders by T-beams which allowed flow circulation along the upstream face of the skin plate; in the alternate design, the main structural members were inclosed in streamlined compartments. W71-08506

OUTLET WORKS, COCHITI DAM RIO GRANDE, NEW MEXICO. HYDRAULIC GRANDE, NEW MEXIMODEL INVESTIGATION,

Army Engineer Waterways Experiment Station,

Army Engineer waterways Experiment Vicksburg, Miss.
Thomas E. Murphy, and Don R. Bucci.
Available from the National Technical Information Service as AD-719 681, \$3.00 in paper copy, \$0.95 in microfiche. Technical Report No 2-705, Nov 1965. 73 p, 49 fig, 2 tab.

Identifiers: \*Dams, \*Design, Hydraulic models, Fluid flow, Piers, Operation, Sand, Silt, \*Cochiti Dam, \*Rio Grande, New Mexico, \*Outlet works, Weirs, Stilling basins.

The combination energy dissipator-irrigation diversion structure was studied in a 1:20-scale hydraulic model to verify and possibly refine the design of the primary and secondary stilling basins, determine the discharge characteristics of the weir between the two basins and each of the two diversion sluices, and investigate qualitatively the performance of the silt sluices. The performance of the energy dissipator was improved by raising the apron of the secondary basin 5 ft and modifying the position of the baffle piers in the primary basin and the size and position of the baffle piers and end sill in the secondary basin. The capacity of the irrigation diversion sluices was found to be adequate. The hydraulic performance of the silt sluices was as anticipated, but at low discharges, fine sand was removed from the model only in the immediate vicinity of the sluice intakes. W71-08507

MATAGORDA SHIP CHANNEL MODEL STU-DY, MATADORDA BAY, TEXAS: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, Miss. Henry B. Simmons, and Henry J. Rhodes.

Available from the National Technical Information Service as AD-719685, \$3.00 in paper copy, \$0.95 in microfiche. Technical Report No 2-711, Jan 1966. 215 p, 122 fig, 31 tab. Identifiers: \*Inland waterways, \*Hydraulic models, \*Bays, Navigation, Hydraulic models, Salinity, Alignment, Site selection, Design, Tides, Mexico Gulf, Texas, Matagorda Ship Channel model, Matagorda Bay, \*Channel improvements, Jetties, Channels, Waterways, Stream flow.

A fixed-bed model of Matagorda Bay was constructed to scale ratios of 1:1000 horizontally and 1:100 vertically as an aid in developing a sound engineering design of the project, including selection of the optimum channel location, design of protective works for the channel, and determination of changes in the hydraulic and salinity regimens that would occur as a result of natural and man-made changes. Several modifications of the basic plan were tested including various lengths of jetties and dikes, with and without assumed accretions; various alignments and side slopes of the entrance channel; and several arrangements of spoil disposal banks. Tests were also conducted to determine the effects on the hydraulic and salinity regimens of the bay of changes in prototype conditions brought about by hurricane and flood conditions, and of future enlargements of the project as may be required by navigation interests. W71-08508

FILLING AND EMPTYING SYSTEM CANNEL TON MAIN LOCK, OHIO RIVER, AND GENERALIZED TESTS OF SIDEWALL PORT SYSTEMS FOR 110 - BY 1200-FT LOCKS HYDRAULIC MODEL INVESTIGATION, Army Engineer Waterways Experiment Station,

Vicksburg, Miss. Jackson H. Ables, and Marden B. Boyd. Available from the National Technical Information

Available from the National Technical Information Service as AD-719686, \$3.00 in paper copy, \$0.95 in microfiche. Technical Report No 2-713, Feb 1966. 157 p, 80 fig, 34 tab, 3 ref. Identifiers: \*Dams, \*Design, Fluid flow, Hydraulic models, Hydraulic systems, Shear stresses, Model tests, Pressure, Kentucky, \*Cannelton Main Lock, \*Ohio River, Locks, Waterways, Sidewall port

The Cannelton main lock will be 110 ft wide by 1270 ft long, pintle to pintle. The hydraulic system was tested in a 1:25-scale model. Tests of 56 sidewall port arrangements resulted in the adoption of the type 45 which is composed of 25 type A ports (2.75 ft wide by 4.07 ft high at the throat) spaced 28 ft on centers in each 16- by 18-ft culvert. The original design culvert intake manifolds and culvert outlets performed satisfactorily. The adopted hydraulic system will permit the lock to be filled in about 8 min and emptied in about 9.5 min with acceptable lock chamber turbulence and hawser stresses. Following the specific tests for Cannelton main lock, generalized tests were conducted on sidewall port arrangements for 110-by1200-ft locks. Results of these tests and recommendations for sidewall port systems in locks of this size are included. W71-08509

SELECTION OF OPTIMUM PLAN FOR IM-PROVEMENTS IN NASSAU, NEW BAHAMAS. HYDRAULIC PROVIDENCES. MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station,

Vicksburg, Miss. Charles W. Brasfeild.

Available from the National Technical Information Service as AD-719238, \$3.00 in paper copy, \$0.95 in microfiche. WES Technical Report 2-696, Oct 1965, 26 p.

Descriptors: \*Breakwaters, \*Model studies, \*Harbors, \*Ocean waves, Ocean currents, Tides, Deep

Identifiers: \*Harbor models, Bahama Islands, Ocean models, Test equipment, Nassau Harbor.

A 1:100-scale model of Nassau Harbor and sufficient offshore area to permit simulation of ap-proaching waves was used to determine the opproacning waves was used to determine the op-timum arrangement and design of certain proposed harbor improvements with respect to wave action and to determine current direction and velocities in the navigation channel and inner harbor area. The proposed harbor improvements consisted of (a) widening and deepening the entrance channel and turning basin; (b) constructing protective breakwaters at the channel entrance; (c) constructing a large artificial island in a shallow area inside the west breakwater; and (d) constructing a new pier in the inner harbor. The model was equipped with wave-generating and wave-measuring apparatus; a water-circulating system was also installed to allow simulation of steady-state tidal flows through the harbor area. It was concluded that navigation conharbor area. It was concluded that navigation conditions would be satisfactory in the entrance channel and the inner harbor following installation of the proposed revisions, provided certain modifications were effected. Modifications recommended included lowering the crown elevation of each breakwater, installing wave absorbers at critical locations along the proposed structures, and relocating the artificial island. Appendix A presents an analysis of the prototype tides and currents in Nassau Harbor.
W71-08510 W71-08510

STABILITY OF RIPRAP AND DISCHARGE CHARACTERISTICS, OVERFLOW EMBANK-MENTS, ARKANSAS RIVER, ARKANSAS: HYDRAULIC MODEL INVESTIGATION, Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Vicksburg, Miss.

N. J. Brogdon, Jr., and J. L. Grace.

Available from the National Technical Information Service as AD-717 873, \$3.00 in paper copy, \$0.95 in microfiche. WES Technical Report 2-650, Vicksburg, Miss, June 1964. 19 p, 5 tables, 19 photos, 48 plates.

Descriptors: \*Dams, .\*Model studies, \*Embankments, \*Riprap, Shore protection, Flow, Scour, Pressure, Roughness, Discharge, Arkansas. Identifiers: Surface roughness, Arkansas River.

Hydraulic model tests were conducted on overflow embankments similar to those which will be integral parts of navigation dams on the Arkansas River to determine the stability of various gradations of protective stone and the discharge characteristics of such structures. The effectiveness of four gradations of riprap, with maximum stone diameters of 16, 24, and 36 in. was investigated on 3- and 10-ft-high, 30- to 35-ft-wide (at crown), access type embankments (i.e. paved roadway on crown), and on 3- and 6.75-ft-high, 20- to 27.5-ftwide, nonaccess type embankments. The embankment designs were furnished by the U.S. Army Engineer District, Little Rock. The tests were conducted on a 1:4-scale section model which reproduced 90 ft of approach channel, a 40-ft-wide section of the overflow embankment, and 140 ft of exit channel. Fiber glass cloth was used to simulate the gravel or crushed rock filters of the prototype. In addition, a 1:12-scale section model was tested in a 1-ft-wide, glass-sided flume to determine pressures on the crest and downstream slope of the embankment. Observations of pressures in the zone where movement of stone was observed revealed (1) instantaneous pressure fluctuations of as much as 1.0 psi (prototype); and (2) reduced average pressures as anticipated. Transition riprap on the roadway shoulder, desirable in the interest of traffic safety, was quite easily displaced and thus was considered unsatisfactory with regard to the desired hydraulic performance. However, the tests indicated that considerably smaller stone can be used on the lower, submerged portions of the downstream slope of an embankment provided such practice is warranted economically. Test results indicate that the combined effect of embankment height and crown width on riprap stability is small, that access type embankments can be considered slightly more stable than nonaccess types, that all stone failure occurred in the zone of free flow, and that the effective or critical size stone of a particular gradation is that which represents 60 to 65 percent by weight of the total. The variation in roughness of the four gradations of stone had no liscernible effect on the discharge characteristics of the overflow embankments within the range of heights (3 to 10 ft) and crown widths (20 to 35 ft) investigated. The discharge characteristics of the two types of overflow em-bankments were essentially the same. Discharge coefficients applicable to the two types of embank-ments were determined for both free and sub-merged flows, and empirical equations were developed. W71-08514

# OPEN-CHANNEL INTEGRATING-TYPE FLOW

Geological Survey, Albuquerque, N. Mex. For primary bibliographic entry see Field 07B. W71-08525

# BREAKER TRAVEL AND CHOICE OF DESIGN

WAVE HEIGHT,
Army Coastal Engineering Research Center,
Washington, D.C.
Cyril J. Galvin, Jr.

ASCE Proceedings, Journal of the Waterways and Harbors Division, Vol 95, No WW2, Paper 6569, p 175-200, May 1969. 26 p, 16 fig, 4 tab, 26 ref, ap-

Descriptors: \*Ocean waves, \*Beaches, \*Break-waters, \*Coastal engineering, \*Shore protection, Hydraulic structures, Model studies, Testing, Test procedures, Harbors, Engineering structures, Wave pile-up, Black Beach erosion.
Identifiers: \*Wave forecasting, Wave runup.

Experiments on three-plane laboratory beaches show that plunging waves travel a horizontal distance of from four to eight times breaker height during the breaking process. This suggests that the potentially damaging effect of breaking waves may be spread over a significant horizontal distance The experiments, as well as previously available data, show that breaker depth-to-height ratios for plunging waves decreases from above 1.3 to below 0.9 as beach slope increases, so that higher waves on steeper slopes may approach nearer to shore be-fore breaking. The combined effect of breaker travel and breaker travel and breaker depth-toheight ratio is such that structures sited in shallow water on moderate or steep slopes can be subject to breaking wave heights significantly larger than the design heights computed according to accepted practice. The experimental results are consistent with a solitary wave description of oscillatory waves at breaking, if the breaker depths of oscillatory waves are appropriately defined, and they are consistent with the limiting heights of breaking waves measured on rubble-mound breakwaters. (Woodard-USGS) W71-08528

# UNSTEADY FREE-SURFACE FLOW COMPU-

Michigan Univ., Ann Arbor. E. B. Wylie.

Proceedings, American Society of Civil Engineers, Journal of the Hydraulics Division, Vol 96, No HY11, p 2241-2251.

Descriptors: Canals, Computer applications, Hydraulics, Free surfaces, \*Open channel flow, Hydrology, Overland flow, \*Unsteady flow, Equations, Numerical analysis, Flow, Channel flow, Methodology, Finite differences, River flow, Computation, Formulation, Momentum equation, Sub-critical flow, Continuity equation, Comparative studies, Fluid mechanics.

Identifiers: \*Method of characteristics.

Solutions of the free-surface equations for subcritical, unsteady, one-dimensional flow by explicit and implicit formulations of the characteristics grid and rectangular grid methods are analyzed. All 4 for-

mulations are based on the method of characteristics. Advantages and disadvantages of each procedure are given. Examples emphasize the important features and corroborate a stability character. portant features and corroborate a stability criterion that is presented. The implicit characteristics grid approach is the most accurate for overland flow situations or analysis of single channels, but is not useful for complex systems. The explicit rectangular grid is the simplest to program, but may lead to instabilities when very large time increments are used. The latter method is also comparatively expensive for long-duration transients. W71-08633

# RESULTS OF FIELD INVESTIGATIONS OF VELOCITIES OF WATER MOVEMENT IN COOLING RESERVOIRS,

B. N. Gorobets.

Gidravl Gidrotekh Mezhvedom Respub Nauch-Tekh Sb, Kiev, No 3, p 132-138, 1966. Transl from Russ, Bur Reclam Transl 844, Jan 1971. 13 p, 6 fig,

Descriptors: Field investigations, \*Thermal power-plants, Salt velocity method, Ponds, \*Cooling, \*Density stratification, Instrumentation, Water circulation, Turbulent flow, \*Velocity distribution, Wind (Meteorology), Hydrodynamics, Model tests, Foreign research, Stratified flow, Cooling systems,

Identifiers: USSR, Richardson number, Vertical temperature gradient, Temperature distribution.

Pond cooling of discharges from thermal powerplants is often used to avoid thermal pollution of streams. Knowledge of the hydrodynamics of cooling ponds and reservoirs is necessary for stable and reliable plant operation. Research to determine velocity distributions in a prototype cooling reservoir with an area of 2.5 sq km, a volume of 16 million cu m, and a depth ranging from less than 6.5 to a maximum of 17.5 m is described. Special instrumentation was developed for measuring the mag-nitude and direction of the reservoir currents. A complex pattern was observed, including spiral motion. Comparisons are made with velocity patterns velocity pattern is caused by: (1) centrifugal inertial forces introduced by bending of the throughflow jet, (2) temperature stratification, and (3) wind action. (USBR)

### BED ROUGHNESS OF A LARGE RIVER IN AN ALLUVIAL CHANNEL,

Mississippi State Univ., State College. Dept. of Civil Engineering.

Victor L. Zitta, and Melville S. Priest.

Victor L. Zitta, and Melville S. Priest. Available from the National Technical Information Service as PB-199 913, \$3.00 in paper copy, \$0.95 in microfiche. Mississippi Water Resources Research Institute, State College, May 1971. 15 p, 8 fig, 2 tab. OWRR Project A-049-MISS (1).

Descriptors: Rivers, River beds, \*Channel flow, Boundary layers, \*Open channel flow, \*Roughness (Hydraulic), Mississippi River.

Data from several reaches of the lower Mississippi River, for a considerable range of discharge, are analyzed for the purpose of establishing a better understanding of the height of bed roughness and its variations along and across the stream. Data relating to the height of bed roughness in the channel, at crossings and at bends, yield to a quantita-tive solution. In this context, the channel is generally 'the deeper part' of the stream. Data relating to lateral variations in height of bed roughness are discussed in a qualitative manner. W71-08662

# USE OF RADIOISOTOPES IN TRACING RESERVOIR LEAKAGE AT ANCHOR DAM, Bureau of Reclamation, Denver, Colo. Chemical

Engineering Branch.
Robert L. Hansen, and Gerald A. Teter.

Available from the National Technical Information Service as TID25396, \$3.00 in paper copy, \$0.95 in microfiche. Report TID25396, July 1970. 28 p, 11 fig, 4 tab, 6 ref.

Descriptors: \*Groundwater flow, Deep wells, Observation wells, Perched water table, Counters, Detectors, Injectors, Water sampling, Temperature sensors, Laboratory equipment, Gamma rays, Beta rays, Flow rates, Field tests, \*Seepage losses, Tracers, \*Radioisotopes, \*Reservoir leakage, Tritium. Flow measurement.

Identifiers: \*Anchor Dam (Wyo), Atomic Energy Commission, \*Radioactive tracers, Mobile laboratories, Cavernous rock.

Radioisotope techniques and equipment were developed to trace the movement of leakage from Anchor Reservoir near Thermopolis, Wyo. Field tests were performed in the summers of 1965, 1966, and 1967. lodine-131 as NaI was applied in the measurement of ground-water velocity using the single drill hole method. Velocity measure ments were made when the reservoir was dry, and results were compared to those obtained when water was impounded behind the dam. Tritiated water was added to the reservoir leakage, and water samples were obtained from drill holes located near the reservoir for analysis of tritium content. Reservoir leakage is through a system of underground caverns which have opened to the surface predominantly at a few discrete areas on the north and northeast sides of the reservoir. Ground-water dissolved oxygen content, tritium tracer experiments, and ground-water level showed that the water cascades into a cavernous system and is carried from the reservoir area in a major escape route, with a relatively small amount being added indirectly to the normal ground-water system. Contribution to the ground-water system causes a temporary water table buildup beneath the W71-08863

# FLOW IN CHUTE SPILLWAY AT FORT RANDALL DAM; HYDRAULIC PROTOTYPE

Corps of Engineers, Vicksburg, Miss.

Carl J. Huval.

Available from the National Technical Information Service as AD-719 687, \$3.00 in paper copy, \$0.95 in microfiche. WES Technical report no 2-716, Apr 1966. 31 p.

Descriptors: \*Dams, \*Model studies, \*Spillways,

Identifiers: Fort Randall Dam.

Tests were conducted in the summers of 1960 and 1962 on the chute spillway of Fort Randall Dam to investigate the characteristics of the supercritical flow and provide data for use in future design work. Measurements were made at mean flow depths from 1.5 to 3.4 ft with average velocities from about 27 to 47 fps. This gave Reynolds numbers from about 1.3 x 10,000,000 to 6.4 x 10,000,000 and Froude numbers from 3.9 to 4.5. Two specially built pitot piers were installed in the spillway chute to measure vertical distributions. Depths of flows along the chute were measured with weighted wire gages. Water-surface depths measured on the chute spillway appeared to be close to the normal depths at the downstream end of the chute. Vertical velocity distributions on the spillway slab were in good agreement with a logarithmic equation for the supercritical flow conditions of the tests. Flow resistance was relatively high, possibly due to the concrete spillway slab joints or water-surface wave effects in the supercritical flow. Equivalent sand grain roughness values and the slope of the velocity distribution curve agree with results of previous investigations. Similar tests at other projects would be of great value, especially if data were obtained in locations on the spillways where nonuniform flow conditions occur.

W71-08865

### Field 08—ENGINEERING WORKS

### **Group 8B—Hydraulics**

EDDY FORMATION BEHIND CIRCULAR CYLINDERS,

California Univ., Berkeley. Dept. of Mechanical Engineering. For primary bibliographic entry see Field 02E.

w71-08910

# REAERATION IN OPEN-CHANNEL FLOW,

Geological Survey, Fort Collins, Colo. J. P. Bennett, and R. E. Rathbun. Geological Survey Open-file Report, April 1971. 314 p, 17 fig, 16 tab, 158 ref, 2 append.

Descriptors: \*Reaeration, \*Dissolved oxygen, \*Oxygen sag, \*Open channel flow, \*Tracers, Reoxygenation, Reviews, Publications, Bibliographies, Photosynthetic oxygen, Biochemical oxygen demand, Air-water interfaces, Path of pollutants, Mixing, Turbulence, Self-purification, Water guality control tion, Water quality control.
Identifiers: Open-channel reaeration.

Reaeration, the physical absorption of oxygen from the atmosphere, is the primary process by which a stream replaces oxygen consumed in the biodegradation of organic wastes. This report con-sists of a review of the literature on methods for measuring and predicting the reaeration coefficient in open-channel flows. The tracer procedure is superior to the dissolved oxygen and disturbed equilibrium techniques for measuring the reaeration coefficient but requires the use of radioactive tracers. Theoretical models of the oxygen absorp tion process are not suitable for prediction of the reaeration coefficient in streams because the model parameters have not been adequately related to the bulk-flow hydraulic variables. Semi-empirical and empirical equations developed from experimental data adequately predict reaeration coefficients for streams of the type of which the equations were based but large errors may occur when the equations are applied to tother types of streams or to conditions outside the variable range considered in the original correlation. Analysis of available data indicates that there is a significant difference between reaeration coefficient regression equations based on flume data and equations based on natural stream data. (Knapp-USGS) W71-08936

### 8C. Hydraulic Machinery

### MARINE FOULING IN POWER STATIONS.

Central Electricity Generating Board, Southampton (England). Marine Biological Lab. For primary bibliographic entry see Field 05D.

### A CRITIQUE OF MHD POWER GENERATION,

Avco-Everett Research Lab., Everett, Mass; and

Argonne National Lab., Ill.
W. D. Jackson, M. Petrick, and J. E. Klepeis.
Transactions American Society of Mechanical Engineers, Ser A–J Eng Power, Vol 92, No 3, p 217-230, July 1970. 14 p, 22 fig, 55 ref.

Descriptors: \*Magnetohydrodynamics, \*Electric power production, Plasma physics, \*Energy conversion, Research and development, Technology, Pilot plants, Electric generators, Economics, Environmental effects, Magnetic fields, Efficiencies, Bibliographies, Electric power, Base loads, Peak loads (Electric), Electric power demand.

Magnetohydrodynamic (MHD) electrical power generation is a technique for upgrading the efficiency of converting heat into electricity. Use of the technique in base-load plants, in addition to increasing overall efficiency, can lead to important reductions in the adverse environmental effects of thermal and air pollution. The projected efficiencies of large dual-cycle systems are initially in the range of 47-50%, and improvements in technology could increase the range to 60%. In an MHD system, energy is extracted from a flowing electrically conducting fluid of either a seeded plasma or a liquid metal. Various MHD power cycles and systems are under consideration. The status of these systems is reviewed, with emphasis on application to large central-station commercial systems. The major technological problems and progress in the 3 major cycles (open cycle, closed-cycle plasma, and closed-cycle liquid metal) are discussed. In the open-cycle system, solutions proposed for the major problems are detailed and experience is summarized. In the closed-cycle plasma system, progress made toward developing a generator with the requisite conversion efficiency is cited. Techniques leading to improved efficiencies are detailed. (USBR)

# NOISE MEASURING AS A COMPLIMENTARY AND CHECKING METHOD FOR PUMP TEST-

Budapest Technical University (Hungary).

J. J. Varga, and G. Sebestyen.

International Association of Hydraulics Research, Symp 1970. Stockholm, Sweden, 1970. 12 p, 15

Descriptors: \*Sound, Acoustics, \*Detection, Noise (Sound), Vibration, \*Pumps, Test results, \*Cavitation noise, Hydraulic machinery, Impellers, \*Pump test, Foreign research, Research and development, Foreign tests, Reliability, Experimental data, Frequency, Accuracy, Efficiencies. Identifiers: Hungary.

Experimental research work in correlating noise level and vibration with cavitation erosion in hydraulic pumps is reviewed. Results of the noise level measurement method developed for acoustic detection of cavitation phenomena show that the method can be very helpful in determining an opinion of the cavitational behavior of hydraulic machines. Without visual observation, the method yields more information than the hydraulic characteristics by making noise level measurements on a single properly chosen frequency. Noise level curves belonging to the characteristic curves of the pump and to the suction capacity curves determine cavitation conditions of the pump over the full delivery range. Noise level measurements increase the reliability of hydraulic measurements and give designers a basis for estimating cavitation behavior of the impeller and pump. (USBR) W71-08631

## ELECTRICAL DESIGN CONSIDERATIONS OF THE NELSON RIVER HVD TRANSMISSION LINE,

Teshmont Consultants. Ltd., Winnipeg (Manitoba).

M. W. Stoddart, and J. F. Graham.

Engineering Journal of Canada, Vol 53, No 10, p 44-50, Oct 1970. 7 p, 9 fig, 2 tab.

Descriptors: \*Electrical design, \*Transmission lines, \*Direct current, Transmission (Electrical), Electric conductors, Electric coronas, \*Extra high voltage, Overhead ground wire, Foreign construction, Guyed towers, Radio interference, Evalua-tion, Economics, Flashover, Lightning, Safety, Electrical insulators, Clearances, Bundled conductors, Overloads,

Identifiers: Canada, Transmission line hardware, Nelson River (Canada).

The Nelson River HVDC Transmission System is part of the overall plan for developing the hydroelectric potential of the Nelson River in Northern Manitoba, Canada. Two bipolar circuits are being installed initially on separate guyed towers along a common right-of-way. The line is 555 mi long with the normal rating of each line being 1620 mw at plus or minus 450 kv and 1800 amps, and an emergency rating of 3600 amps. The main electrical parameters of the transmission line are summarized. Twin 1.6-in. conductors were selected on the basis of loss evaluation and emergency overload capability. Grading rings will be

provided on dead-end hardware only. Insulator strings were selected on the basis of normal working voltage. Ground clearances established for the HVDC line are consistent with accepted safety standards applied to HVAC transmission. The use of overhead ground wire shielding is expected to limit lightning flashovers to 2/yr/100 mi of line. (USBR) W71-08634

# CONVERSION OF HYDROELECTRIC PLANT TO REMOTE CONTROL, North of Scotland Hydro-Electric Board, Edin-

burgh. W. M. Ross, and E. G. Davidson. Water Power, Vol 22, No 9, p 305-311, Sept 1970.

Descriptors: Hydroelectric power, \*Hydroelectric powerplants, Electric power production, Costs, \*Remote control, \*Automatic control, Supervisory control (Power), Foreign design practices, Communication, Telemetry, Electrical equipment. Identifiers: Scotland, Modernizing, Communication systems, Security.

The conversion of 2 North of Scotland Hydro-Electric Board's hydroplants to remote control is described. The North of Scotland Hydro-Electric Board has 1052 mw of hydroelectric generation scattered throughout 45 stations ranging from 2 mw to 40 mw at operating heads ranging from 1362 ft to 34 ft. Most plants are on semiautomatic or fully automatic control, with a few remaining on manual control. Increasing staffing costs have necessitated considering remote control for more of the small plants. Based on the total cost of conversion, the expected return on capital investment, allowing for depreciation and maintenance, will be not less than 20%. Operations have been satisfacto-ry. (USBR) W71-08635

#### FREQUENCY CONTROL UNDER ISOLATED NETWORK CONDITIONS.

Water Power, Vol 22, No 9, p 320-324, Sept 1970. 5 p, 8 fig, 2 tab, 8 ref.

Descriptors: \*Load-frequency control, Interconnected systems, Damping, Time, Frequency shifts, \*Hydraulic turbines, \*Governors, Investigations, Hydroelectric powerplants, Regulation, Fluctuation, Control, Frequency, Foreign research, Electrical stability, Hydroelectric power.

Identifiers: Austria, \*Frequency response, Optimum performance, Sakingen Power Sta (West Germany)

Frequency behavior is important during a breakdown of interconnections to a grid leaving hydrau-lic turbines to supply an isolated network. Providing a governor setting which gives best control sta-bility is not sufficient because a change of setting to improve stability may cause deterioration of frequency control with larger frequency overshoot. Good frequency control of an isolated network is essential because the relative local load variations are larger in relation to the total power than in an interconnected grid. Frequency deviation must not be limited only to satisfy requirements of the customers during the isolated operation, but also to permit easier return to the interconnected grid service as soon as possible. Based on measurements of the frequency response of hydraulic turbine governors with more than one input amplitude, a new concept has been tested to achieve optimum setting, considering the effect of nonlinearity of servomotor speed and the fact that large units cannot be tested on actual isolated networks. Frequency-response tests are discussed and evaluated. (USBR)
W71-08636

#### REINFORCED CONCRETE RESPONSE TO SIMULATED EARTHQUAKES.

T. Takeda, M. A. Sozen, and N. N. Nielsen.

#### Soil Mechanics—Group 8D

Proceedings American Society of Civil Engineers, Journal of Structured Division, Vol 96, No ST12, p 2557-2573, Dec 1970. 17 p, 13 fig, 2 tab, 2 ref, 2 append.

Descriptors: Dynamic tests, \*Dynamic response, Displacements, Damping, \*Earthquakes, \*Reinforced concrete, Structural engineering, Acceleration (Physics), Vibration, Simulation, Structural behavior, Laboratory tests, Seismic tests, Stiffness. Identifiers: Hysteresis loops, Static behavior.

Reinforced concrete specimens were subjected to static tests and periodic and simulated earthquake motions to develop realistic analytical models for the earthquake response of the elements and materials involved. During some dynamic tests, the materials involved. During some dynamic tests, the specimens responded with a displacement of the order of 6 times the initial yield deflection. The stiffness and energy absorbing capacity of the specimens changed considerably and, at times, very rapidly during the dynamic tests. A realistic conceptual model for predicting the dynamic response of a reinforced concrete member should be based on a static force-displacement relationship reflecting the changes in stiffness for loading and unloading as a function of the previous loading history. ing the changes in stiffness for loading and unloading as a function of the previous loading history. The dynamic response calculated on the basis of the proposed force-displacement relationship agreed satisfactorily with the measured response. With the hysteresis loops defined by the proposed force-displacement relationship, invoking additional sources of energy absorption was not necessary for a satisfactory prediction of the dynamic response. (USBR)

#### CLEAN POWER FROM INSIDE THE EARTH,

J. Lear.

Saturday Review, Vol 53, No 49, p 53-61, Dec, 1970.7 p, 8 fig.

Descriptors: \*Geothermal powerplants, \*Geothermal studies, Electric power, Electric power production, Electric powerplants, Power supplies, Research and development, Environmental effects, Resource development, Thermal power, Water strate Description

supply, Desalination. Identifiers: \*Geothermal investigations, \*Geothermal resources.

A powerplant to turn geothermal steam into electric power is being constructed in the Mexicali Valley in Mexico. The powerplant will have a capacity of 75,000 kw, with plans for quadrupling this output. A research program is underway to investigate development of geothermal power north of the Mexican Border in the Imperial Valley in California. The Bureau of Reclamation contributes to the research primarily because of the possibility of producing substantial volumes of slat-free water for the Colorado River. The scheme is to pipe geother-mally heated water to the surface of the Imperial Valley, take off the steam to generate power, use the heat remaining in the brine to evaporate the water, pipe the distilled water into Lake Mead, and refill the geothermal reservoir underground with salt water from the Pacific Ocean. The present use and potential of geothermal power in the U S and other parts of the world are discussed. Geothermal power can be generated more inexpensively than power from any other source and, under proper management, is capable of enhancing rather than deteriorating the environment. (USBR) W71-08643

# FINAL REPORT AND EVALUATION OF EX-PERIMENTAL TOWERS IN THE 230-KV GLEN CANYON-SHIPROCK TRANSMISSION LINE, Bureau of Reclamation, Denver, Colo.

H. Brenman.

Bureau of Reclamation Report REC-ERC-71-3, Jan, 1971. 21 p, 15 fig, 5 tab.

Descriptors: \*Transmission towers, Transmission lines, Investigations, \*Erection, \*Guyed towers, Helicopters, Cranes (Hoists), Costs, Design, Reliability, Feasibility, \*Experimental data, Performance, Evaluation, Environmental effects, Maintenance

Identifiers: Test transmission lines, \*Self-supporting towers

Results of a 6-yr investigation program of new tower designs and erection procedures for transmission lines are reported. The 7-mi test section of a 230-kv transmission line near Kayenta, Ariz, consisted of 4 towers each of 7 types, some erected by cranes and some erected by helicopter. Installed cost data are given. The 6-yr service reliability was satisfactory for the experimental section of transmission line. Feasibility of helicopter erection was satisfactory. Tower designs based on guyed construction were acceptable. Self-supporting towers were very economical. Environmentally, use of guyed towers should be avoided near substations, highways, or in agricultural fields. Basic design data of the transmission line and tower design data are given. (USBR) W71-08646

#### ENGINEERING FUNDAMENTALS INVOLVED IN BOTTOM-HOLE-TOOL DRILLING, Mission Mfg. Co., Houston, Tex.

I D. Gardner.

Water Well Journal, Vol 14, No 3, Mar 1960. 5 fig.

Descriptors: \*Water wells, \*Drilling, Rotary drilling, Drilling equipment, Drilling fluid, Oil industry. Identifiers: \*Bottom-hole-tool drilling, Cable-tool

drilling, Hard-rock drilling.

A major change in the basic equipment requirements was made when rotary drilling rigs using mud were introduced to the water well industry. Since this time only the accessory equipment was needed to add air as a drilling fluid and obtain an increase in drilling rates. With the introduction of 'Bottom-Hole-Tools,' the air compressor manufacturers have kept up with their needs. It is the purpose of this paper to present the fundamentals involved in 'Bottom-Hole-Drilling.' (Campbell-NWWA)

#### A CRITICAL EXAMINATION OF ROTARY DRILLING HYDRAULICS,

Texas Univ., Austin.

T. Bourgoyne, and O. K. Kimbler.

Preprint, Society of Petroleum Engineers of AIME Paper No SPE 2386, 1969. 13 p, 2 tab, 14 fig, 20

Descriptors: \*Drilling, \*Rotary drilling, Drilling fluids, Drilling equipment, Oil industry. Identifiers: \*Drilling hydraulics, Bit nozzle size, Maximum bit horsepower, Maximum nozzle velocity.

A new computer technique has been developed for providing information on rotary drilling hydraulics. The computer program determines the proper bit nozzle size and pump operating conditions for all combinations of depth and mud density for a given hole size. By performing the calculations for all hole sizes used, the program completely defines optimum hydraulics for a given rig. making repetitive calculations for each well unnecessary. The computer program presented was used to compare various published optimization procedures over a typical range of field conditions. The optimization procedures studied were (1) establishment of maximum jet impact force, (2) establishment of maximum bit horsepower, (3) establishment of maximum nozzle velocity, (4) establishment of known cleaning needs with the least pump horsepower expenditure, and (5) establishment of optimum bit horsepower using the Economy Method. The comparison includes differences among the procedures in pump cost as well as the differences in the hydraulic horsepower, jet impact, and nozzle velocity of the bit. (Campbell-NWWA) W71-08916

WHAT TO LOOK FOR IN SELECTING AIR-DRILLING FOAMING AGENTS, Aqua-Flo Co., Nitro, W. Va.

T. Halloran.

Oil and Gas Journal, Vol. 67, No. 23, August 8,

Descriptors: \*Drilling fluids, \*Rotary drilling, Drilling, Drilling equipment, Oil industry. Identifiers: \*Air-drilling foaming agents, Appalachian fields, Detergents, Foaming methods.

To get the most out of air drilling, operators looked for better foaming agents. Most surfactants available for oil-field use in the late 1950's were byproducts or detergents made for other industrial, or even household uses. These products were not vereven nousenoid uses. These products were not versatile enough for the wide range of oil-field conditions. Many of the problems with conventional detergents arise from their inability to work well in other than fresh water. Brine, sulfur water, and oil ry detergents can give good results in every type of fluid to which they are exposed. (Campbell-NWWA)
W71-08924 cause the major difficulties. Few soaps and ordina-

AUTOMATION OF SMALL RURAL WATER SUPPLY SYSTEMS (RUSSIAN: AVTO-MATIZATSIYA MALYKH SISTEM SEL'SKOK-HOZYAYSTVENNOGO VODOSNABZHENIYA),

A. I. Fabrikov, and L. S. Blagovestnyy. Gidrotekhnika i Melioratsiya, No 1, p 84-89, January 1971. 6 p, 3 fig, 1 tab.

Descriptors: \*Automation, \*Water supply, \*Pumps, Water delivery, Discharge (Water), Rural areas, Equipment. Identifiers: \*USSR, Water pipes.

Automation of rural water supply lines will result in significant economic gains by reducing the cost of maintenance and by increasing the discharge and smooth-flowing operation of pump units. Existing rural supply lines can be automated without great capital expense, particularly if one uses the automatic pressure limit switch disigned by the Southern Scientific Research Institute of Hydraulic Engineering and Reclamation. The switch is quite complete in design. simple in design. Its most vital component is the diaphragm. Laboratory and production tests of various diaphragms have shown that polymer materials have great residual deformations resulting in disturbance in the same production. ing in disturbances in the adjustment. Tests of rubber diaphragms reveal a lesser disturbance in the original adjustment. The minimum limit of level adjustment achieved to date--3 m of water columnis considered to be satisfactory. (Josefson-USGS)

#### 8D. Soil Mechanics

A METHOD OF PROTECTING BANKS OF THE AMU-DARYA RIVER (RUSSIAN: SPOSOB KREPLENIYA BEREGOV REKI AMU-DAR'I), N. I. Kryuchkov, and V. V. Mlynskiy. Gidrotekhnika i Melioratsiya, No 1, p 44-47, Jan 1071, 42-25c.

1971. 4 p, 2 fig.

Descriptors: \*Bank protection, \*Bank stabilization, \*Bank erosion, \*Coastal structures, \*Trenches, Coastal engineering, Erosion, Discharge (Water), Meanders, Clays, Alluvial channels, River training. Identifiers: \*USSR, Karakaplak ASSR, Amu-Darya River, Bottom erosion, Angle of repose.

The Takhiatash water engineering system on the Amu-Darya River is being built in an unstable river channel. Discharge of the river ranges from 100 to 8,000 cu m/sec. Sharp changes in the slopes of the water surface (from 0.0001 to 0.0002) produce a meandering channel on the alluvial-delta plain of the river. To protect the banks of the river it is recommended that rocks be dumped into excavated trenches along the projected line of ero-sion, provided that rock interlayers or thick layers

#### Field 08—ENGINEERING WORKS

#### **Group 8D—Soil Mechanics**

of clay are present at the bottom limits of the eroon cay are present at the ootiom limits of the ero-sion. By using this method river banks may be given the necessary configuration and the direction of flow may be changed at will. (Josefson-USGS) W71-08584

### AN EXTENSION TO THE THEORY OF THE CONSTANT HEAD IN SITU PERMEABILITY

TEST, London Univ. (England).

R. E. Gibson.

Geotechnique, Vol 20, No 2, p 193-197, June 1970. 5 p, 2 fig, 19 ref.

Descriptors: \*Permeability, Permeability coefficients, Bibliographies, \*Permeability tests, \*In situ cients, Bibliographies, \*Permeability tests, \*In situ tests, Theory, Soil tests, Soil mechanics, Piezometers, Pore water pressure, Flow rates, Theoretical analysis, Soil investigations, Soils, Analysis, Foreign research. Identifiers: Great Britain.

The theory of the in situ constant head permeability test (Gibson 1963) is strictly valid only if the soil chaves as a porous perfectly elastic medium. For behaves as a porous perfectly elastic medium. For this ideal soil, the flow rate is given by an expression which holds not only for inflow and outflow tests, but also for either a rigid or an infinitely compressible piezometer tip—a spherical cavity. The theory has been extended to take account of the anelastic behavior of real soils. The piezometer compressibility, the magnitude of the pore water pressure parameter of the surrounding soil, and the direction of flow all have an important influence on the relation between flow rate and time. (USBR) W71-08623

#### GROUND MOTIONS FROM VIBRATORY ROLLER COMPACTION OF COHESIVE SOIL, Bureau of Reclamation, Denver, Colo.

D. A. Tiedemann.

Bureau of Reclamation Report REC-OCE-70-28, June 1970. 23 p, 12 fig, 7 tab, 9 ref, append.

Descriptors: \*Soil compaction, \*Soil dynamics, Soil mechanics, Tamping rollers, Soil tests, Com-paction equipment, Compaction tests, Test fills, In-strumentation, Rolled fills, \*Vibration, \*Vibratory compaction, Field tests, \*Cohesive soils, Electronic equipment, Accelerometers, Effects, Acceleration (Physics), Embankments, Seismic

Damages. Identifiers: Cawker City Dike (Kans), Vibratory

A field test was conducted to obtain information concerning the compaction characteristics of a vibratory sheepsfoot roller used in constructing an embankment of cohesive soil. As a part of the test, the magnitude of ground motions produced by the vibratory roller was measured. Measurements were obtained by installing 5 triaxial sets of accelerometers in the embankment as construction progressed. Measurements were obtained over horizontal distances of 0 to 50 ft and depths ranging from about 2.0 to 22.5 ft. Results indicated that: (1) relatively high ground motions were produced in the immediate vicinity of the roller, with accelerations exceeding 1 g up to a depth and distance of 5 ft from the roller; (2) vibrations were directional, with the vertical components to the front of the roller being 2 to 3 times greater than those to the side; (3) higher ground motions were produced by the roller when stationary than when moving; (4) the magnitude of ground motions appeared to depend on the moisture content of the soil directly beneath the roller; (5) the phenomenon of beating occurred when 2 rollers were operated near each other; and (6) based on available damage criteria, the risk of damage should be considered when the roller is operated near structures. (USBR) W71-08624

THE FACTOR OF SAFETY AGAINST UN-DRAINED FAILURE OF A SLOPE, Melbourne Univ. (Australia).

P. J. Moore.

Soils and Foundations, Vol 10, No 3, p 81-91, Sept 1970. 11 p, 9 fig, 10 ref.

Descriptors: \*Slope stability, \*Stability analysis, \*Safety factors, Slopes, Embankments, Earth dams, Shear failure, Pore pressure, Effective stress, Shear strength, Shear stress, Soil mechanics, Equations, Foreign research, Failure (Mechanics), Slipciple method. circle method.

Identifiers: Undrained shear strength, Friction circle method, Bishops method, Fellenius method,

Conventionally in the Fellenius, Bishop, and friction circle methods of slope stability analysis, the factor of safety is defined in terms of the failure shear stress that may be mobilized at the existing in situ value of effective normal stress. Additional pore pressure change (positive or negative) that may occur between the in situ state and the failure state when the possibility of undrained failure is being examined is not considered. The safety factor for undrained failure of a slope is redefined in terms of the shear stress on the failure plane at failure, and equations are derived for the above 3 methods of stability analysis that allow for the development of additional pore pressures. The redefinition of the factor of safety is more logical and more valid than the conventional definition. The equations are applied to the analysis of the failure of the Seven Sisters embankment in Canada. (USBR) W71-08629

#### NONLINEAR ANALYSIS OF STRESS AND STRAIN IN SOILS,

California Univ., Berkeley; and Woodward-Clyde-Sherard and Associates, Oakland, Calif. J. M. Duncan, and C-Y Chang.

Proceedings, American Society of Civil Engineers, Journal of Soil Mechanics and Foundations Division, Vol 96, No SM5, p 1629-1653, Sept 1970. 25 p, 19 fig, 1 tab, 27 ref, 2 append.

Descriptors: Soil investigations, \*Soil mechanics, \*Strain, Analytical techniques, Soil properties, \*Soils, Soil tests, \*Finite element method, \*Stressstrain curves, \*Stress, Stress analysis, Computer applications, Footings, Settlement (Structural), Bibliographies, Triaxial tests. Identifiers: \*Nonlinear properties.

The availability of high-speed computers and powerful numerical analytical techniques such as the finite element method have enabled approximating nonlinear, inelastic soil behavior in stress analysis. Nonlinear stress analyses of soils require descriptions of the stress-strain behavior of the soil in quantitative terms and techniques for incorporating the behavior in the analyses. A simple, practical stress-strain relationship representing the nonlinear, stress-dependent, inelastic stress-strain behavior of soils is described. The relationship is convenient for use with the finite element method of analysis. Values of the required parameters used in the relationship can be derived from the results of standard triaxial tests or plane strain compression tests involving primary loading, unloading, and reloading. Comparisons of calculated and mea-sured strains in specimens of dense and loose silica sand showed that the relationship was capable of accurately representing the behavior of the sand under complex triaxial loading conditions, and analyses of the behavior of footings on sand and clay showed that finite element stress analyses conducted using the relationship agreed well with empirical observations and applicable theories. W71-08630

#### SEISMIC SAFETY OF EARTH DAMS.

Ohio State Univ., Columbus; and Auburn Univ.,

T. H. Wu, and L. M. Kraft, Jr.

Proceedings, American Society of Civil Engineers. Journal of the Soil Mechanics and Foundations Divisions, Vol 96, No SM6, p 1987-20006, Nov 1970. 20 p, 9 fig, 5 tab, 26 ref, 2 append. Descriptors: Dams, \*Earth dams, \*Dam design, \*Seismic stability, Loads (Forces), Seismic design, Decision making, Slope stability, Earthquakes, Safety factors, Safety, Soil mechanics, Risks, Earthquake loads, Dynamic response, Statistical analysis, Probability, Optimum design, Costs, Soil properties, \*Optimization, Bibliographies, Shear strength, Dam failure.

Use of statistical decision theory to choose an optimum safety probability in earth dam design is illustrated conceptually. The safety of a homogeneous earth dam designed by a set of procedures deemed representative of current practice is considered. Based on published research results, variance of the procedure of the procedur ous uncertainties and errors are evaluated and used to compute the failure probability of an earth dam located in a seismic region. Decision theory is used to obtain the optimum design. This approach permits evaluating the effects of various uncertainties on the safety and cost of an earth dam and provides a basis for choosing design parameters. Examples illustrate numerically the effect of seismicity, material properties, and failure cost on design and expected cost. (USBR)

## HYDRAULIC MODEL STUDIES OF TIBER DAM AUXILIARY OUTLET WORKS MISSOU-RI RIVER BASIN PROJECT MONTANA,

Bureau of Reclamation, Denver, Colo. Engineering and Research Center. G. L. Beichley.

Available from the National Technical Information Service as PB-197 834, \$3.00 in paper copy, \$0.95 in microfiche. Bureau of Reclamation report REC-OCE-70-44 Oct 1970. 34 p.

Descriptors: \*Earth dams, \*Outlet works, \*Reservoirs, \*Model studies, Irrigation pressure, Drainage, Montana, Stilling basins, Slide gates. Identifiers: \*Drop inlets, \*Tiber Dam, \*Missouri River Basin Project.

The existing canal outlet works tunnel at Tiber Dam, Mont, is used as an intake and as the upstream portion of an auxiliary outlet works designed to provide additional reservoir release capacity. The existing 17-ft-dia horseshoe free flow tunnel is converted to a 15-ft 6-in-dia pressure tunnel and is connected to a new 10-ft 9-in.-dia tunnel by a drop inlet and vertical bend. The smaller tunnel is equipped with a 7.25- by 9.25-ft slide gate and terminates in a stilling basin in the river chan-nel. A 1:17.53 scale model was used to develop the hydraulic design of the auxiliary outlet works including: the drop inlet and vertical bend from the existing canal outlet works tunnel, and the transition in the tunnel downstream from the gate chamber. Details of the model testing and recommended modifications to the preliminary design prompted by the testing are presented. W71-08864

#### AGING EFFECTS ON SWELL POTENTIAL OF

COMPACTED CLAY,
Technion - Israel Inst. of Tech., Haifa (Israel).
Dept. of Civil Engineering.
For primary bibliographic entry see Field 02G.
W71-08904

#### 8E. Rock Mechanics and Geology

#### PHASE COMPOSITION OF PORE WATER IN COLD ROCKS.

Cold Regions Research and Engineering Lab., Hanover, N.H.

For primary bibliographic entry see Field 02G. W71-08504

## WATER FLOWS IN FISSURED ROCK AND THEIR EFFECTS ON THE STABILITY OF ROCK MASSIFS, Karlsruhe Univ. (West Germany).

Available from the National Technical Information Service as UCRL-Trans-10469, \$3.00 in paper copy, \$0.95 in microfiche. Ph D Thesis, Karlsruhe University, May 1970. 207 p, 79 fig, 52 ref.

Descriptors: \*Engineering geology, \*Groundwater movement, \*Hydrostatic pressure, \*Rock mechanics, \*Fissures (Geology), Aquifer characteristics, Porous media, Aquifers, Joints (Geology), Fractures (Geology), Foundation rocks, Landslides, Dam failure, Structural geology. Identifiers: Fissured rocks, \*Engineering hydrology.

In the engineering sciences the study of the stability of rock massifs is among the trickiest problems that one can encounter. The complexity of the problem is increased by the fact that, under natural conditions, rock massifs are fissured. Because of this fissured because of this fissured because of this fissured because of this fissured because of the same than tions, rock massifs are fissured. Because of this fis-suring, rock massifs are not homogeneous and isotropic media. Water-flow phenomena in rock massifs are analyzed taking into account the anisotropy due to fissuring. Some analytic methods are given for determining the static and dynamic actions of the water in fissured media. These flow forces can then be introduced into stability analyses. (Knapp-USGS)

#### A MEANS OF DETERMINING THE COMPLETE STATE OF STRESS IN A SINGLE BOREHOLE,

Kyoto Univ. (Japan); and British Columbia Univ., Vancouver.

Y. Oka, and I. Bain.

International Journal of Rock Mechanics and Mining Science, Vol 7, No 5, p 503-515, Sept 1970. 13 p, 11 fig, 1 tab, 1 ref, append.

Descriptors: \*Rock mechanics, \*Rock tests, Rock pressures, Boreholes, In situ rock, \*In situ tests, Field tests, Stress, Calibrations, Stress relieving, Instrumentation, Measuring instruments, Strain, Methodology, Displacements, Stress analysis, Stress distribution, Foreign research, Equations, Mathematical analysis, Analytical techniques. Identifiers: \*Overcoring method, Japan, Canada.

Equations for determining the complete state of stress in a rock mass from a single borehole are derived. Instrumentation that will measure enough derived. Instrumentation that will measure enough components of displacement of the walls of a single overcored borehole to permit computation of the complete stress ellipsoid is proposed. A new device capable of measuring 3 vectors of axial displacement is described. Coefficients derived from established formulae are used in computing the in situ stress tensor. Calibration of the measuring system using 4 test blocks of rock with various orientations of borcholes and loading directions is explained. Calibration eliminates the need for using elastic constants which allow determination of stresses in heterogeneous rock. Because only stresses of equilibrium are involved, a soft or rigid type of measuring instrument may be used. (USBR) W71-08628

#### UNIAXIAL TESTING IN ROCK MECHANICS LABORATORIES,

LABORATORIES, Sheffield Univ. (England). I. Hawkes, and M. Mellor. Engineering Geology, Vol 4, No 3, p 179-285, 1970. 107 p, 37 fig, 9 tab, 131 ref, 4 append.

Descriptors: \*Rocks, Samples, Compression tests, Laboratory tests, \*Test procedures, Equipment, Errors, Deformation Bibliographies, \*Rock mechanics, \*Rock properties, \*Rock tests, Tension tests, Tolerances (Mechanics), Fractures. Identifiers: Uniaxial tests.

Laboratory testing of rock specimens in uniaxial tension and compression is reviewed, with the aim of selecting equipment, procedures, and tolerances as a basis for test standardization. Major topics of the review include composition, condition and

preparation of test materials, theoretical background of deformation and fracture in rocks, detailed mechanics of uniaxial laboratory tests, and practical test procedures. (USBR) W71-08648

#### A LABORATORY STUDY OF BREAKAGE BY ROTARY DRILLING, ROCK

California Univ., Berkeley.

analyses, Drilling efficiency.

W. H. Somerton.

Journal Petroleum Technology, Vol 219, No 5, p 92-97, May 1959. 11 fig, 3 tab, 10 ref.

Descriptors: \*Drilling, \*Rotary drilling, Oil industry, Drilling equipment, Rock mechanics.
Identifiers: \*Drilling variables, Turbodrill, Energy considerations, Bit wear studies, Drilling chip

The effects of drilling variable on rotary drilling rates and efficiencies have been studied by a series of laboratory drilling test. Two-cone 1.25-in. diameter bits were used to drill vertically upwards into rock samples at controlled weights and rates of rotation. Shale, sandstone and specially prepared concrete samples were used in this study. Power input to the drilling system was measured and input to the drilling system was measured and drilling chips collected for energy -- size reduction studies. Reasonably good correlations between drilling variables and rates of penetration were found. Quantities that are difficult to evaluate include rock strength parameters and the effects of bit wear. Effects of bit size and geometry require further investigation. Analysis of the drilling chips confirmed the premise that, for rocks containing two or more mineral constituents of different strengths, a greater amount of rock breakage occurs in the weaker constituent. Drilling conditions which required greater amounts of energy produced finer drilling chips. As bit tooth wear progressed, drilling chips became finer. Efficiency of rotary drilling as a rock breakage mechanism was extremely low. Comparison was made with theoretical energy requirements and with energy requirements for size reduction by comminution methods. (Campbell-NWWA) W71-08845

#### 8F. Concrete

## PLACEMENT OF CONCRETE IN MASSIVE HYDRAULIC STRUCTURES BY USING PRECAST SEPARATING ELEMENTS,

R. N. Petrashen. Hydrotechnical Construction, No 1, p 23-27, Jan 1970. 5 p, 9 fig, 3 ref.

Descriptors: \*Concrete dams, \*Concrete placing, Construction, \*Foreign design practices, Foreign construction, Formwork (Construction), Gravity dams, Temperature control, Cracking, Grouting, Shear forces, Hydraulic structures, Construction costs, Reliability, Construction methods, \*Dam

construction. Identifiers: USSR.

Soviet engineers are using a new method of placing concrete in large hydraulic structures being built under severe climatic conditions. The method consists of systematic use of internal precast embedded forms as elements permitting the division of the structure into separate blocks. By using this method, the entire concrete-placing scheme is basically modified, converting it into a continuous process of gradual construction of the dam by layers. The method involves uninterrupted placement of concrete, beginning at the upstream side and progressing to the downstream side, by placing blocks with embedded separating elements. The distance between the elements is established so that no formation of temperature cracks occurs during cooling of the dam. The embedded elements in each higher layer are displaced toward the downstream side to form a stepped joint which can adequately transfer shearing forces from the up-stream to the downstream side. Details of the con-struction method are discussed. (USBR)

W71-08626

# LOWER-BOUND OPTIMAL DESIGN OF CONCRETE STRUCTURES, Monash Univ., Clayton (Australia); and Waterloo Univ. (Ontario).

Univ. (Ontario).
G. I. N. Rozvany, and M. Z. Cohn.
Proceedings, American Society of Civil Engineers,
Journal of the Engineering Mechanics Division,
Vol 96, No EM6, p 1013-1030, Dec, 1970. 18 p, 7
fig, 1 tab, 13 ref, 2 append.

Descriptors: \*Limit design, \*Reinforced concrete, Concrete structures, Continuous frames, Continuconcrete structures, Continuous traines, Continuous beams, Design, \*Optimization, Constraints, Engineering mechanics, \*Optimum design, Load distribution, Axial loads, \*Linear programming, Reinforcing steels, Stiffness. Identifiers: Yielding, Concrete slabs.

A formulation of the optimal frame and slab problems is presented, in which specified servicea-bility and collapse criteria are satisfied in addition bility and collapse criteria are satisfied in addition to the objective of minimizing the material consumption. The approach: (1) considers alternative loading conditions, (2) is based on the lower bound principle, and (3) with appropriate assumptions, leads to the solution of a linear programing problem. Examples of application to a 2-bay frame and a circular slab illustrate the approach. Possible refinements such as the consideration of axial forces and nonlinearity of the moment-steel area relation are investigated. (USBR) W71-08642

#### CEMENT CONCRETE--RESEARCH, TESTING, AND PERFORMANCE, Waterways Experiment Station, Vicksburg, Miss.

B. Mather. Journal of Materials, Vol 5, No 4, p 832-841, Dec. 1970. 10 p.

Descriptors: \*Concrete technology, Concretes, Descriptors: \*Concrete technology, Concrete, Admixtures, Performance, Aggregates, Concrete construction, Concrete tests, Nondestructive tests, Chemical properties, Abrasion resistance, Research and development, Data processing, Particle distribution, Particle size, Statistical analysis, \*Portland cements, Spectroscopy, X-ray diffraction, \*Reviews.

Identifiers: American Society for Test and Mat, American Concrete Inst, Portland Cement Association, Marburg Lecture.

Selected aspects of the state-of-the-art of predicting performance of portland cement concrete in service are reviewed. The role of research in evaluating the performance and guiding the development of tests is discussed. Remarkable progress has been made, but much remains to be done to provide basic and fundamental knowledge of the phenomena, the substances, and the environment of service. A better understanding of the nature and formation processes of the bonds that give concrete strength, the processes by which the bonds become broken, and the critical levels of in-teracting environmental factors that produce irreversible changes in concrete in service is needed. Such research results will permit the planning of experiments that will yield data to establish rela-tions between levels of relevant properties and performance in levels of environmental influences. From such relations, performance may be predicted; from such predictions, test methods and specifications can be established. (USBR) W71-08647

CEMENTING SMALL WELLS, Miller (J. P.) Artesian Well Co., Brookfield, Ill. For primary bibliographic entry see Field 08A. W71-08667

#### DETERIORATED CONCRETE IN NORTH PLATTE RIVER PROJECT SUBSTATIONS,

Bureau of Reclamation, Denver, Colo. Engineering and Research Center.

#### Field 08—ENGINEERING WORKS

#### **Group 8F—Concrete**

Available from the National Technical Information Service as PB-197 844, \$3.00 in paper copy, \$0.95 in microfiche. Bureau of Reclamation Report REC-ERC-71-7, Jan 1971.

Descriptors: \*Concretes, \*Concrete testing, \*Cracks, \*Foundations, Deterioration, Failures, Concrete constructions, Substations, Alkali-aggregate reaction.

Identifiers: \*Foundation deterioration, Aging tests, Materials, Visual inspection, Silicon dioxide, Nebraska, Wyoming, North Platte River, Concrete

Inspection of several electrical substations of the Bureau of Reclamation shows concrete in various stages of deterioration from severe to slight cracking. Concrete cores obtained from visibly deteriorated foundations at Bridgeport and Sidney, Nebr, and Laramie, Wyo, show damage from a variety of causes. Bridgeport deterioration is at-tributed principally to fire damage. Sidney concrete is seriously deteriorated, badly cracked, and crumbly. In the absence of complete construction records, inadequate inspection and poor-quality workmanship are the suspected causes. Concrete in Laramie Substation is deteriorating from alkalisilica aggregate reaction. W71-08868

#### 8G. Materials

#### SELECTION OF CHEMICAL GROUT FOR MATTMARK DAM,

Massachusetts Inst. of Tech., Cambridge; and Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau and

H. H. Einstein, and G. Schnitter.

Proceedings, American Society of Civil Engineers, Journal of the Soil Mechanics and Foundations Division, Vol 96, No SM6, p 2007-2023, Nov 1970. 17 p, 14 fig, 17 ref, append.

Descriptors: \*Chemical grouts, Dams, Hydraulic structures, \*Grouting, \*Grout curtains, Laboratory tests, Leaching, \*Evaluation, Permeability, Soil mechanics, Viscosity, Stability, Injection, Foreign research, Soil investigations, Shrinkage, Deformation, Deterioration, Seepage control, Bibliographies, Dam foundations, Cutoffs, Overburden. Identifiers: Gelation, Switzerland, Mattmark Dam (Switzerland).

Four chemical grouts, 2 nearly identical sodium silicates (algonite and consonda), and 2 polymers (bakelite and polythixon) underwent extensive laboratory evaluation. First, the grouts were examined with regard to viscosity--time behavior, gelation time, temperature-influence, stability, deformability, and toxic properties. Bakelite was climinated because of rigid deformability. The second step tested grout-soil interaction: the injectability and permeability reduction of algonite and polythixon were examined in laboratory injection tests. Both grouts reduced permeability by an order of magnitude, but polythixon was eliminated because of limited injectability. Finally, long-term leaching tests on algonite were performed to investigate the effect of syneresis. Satisfactory results led to the recommendation of algonite for eventually successful application. The evaluation procedure used is generally valid for any grout selection. (USBR) W71-08639

#### 8H. Rapid Excavation

POWERFUL BOREHOLE SLURRY PASSES FIELD TESTS.

Western Co. of North America, Richardson, Tex A. M. Spencer, A. L. Anderson, and G. R. Dysart. World Oil, Vol 171, No 6, Nov 1970. 3 fig, 1 tab, 8

Descriptors: \*Rock mechanics, Boulders, \*Water wells, Aquifer characteristics, Oil industry, Drilling, \*Explosives, \*Excavation, Wells. Identifiers: Tensile failure, Random fracturing, Slurry explosives, Stimulation depth.

The most powerful commercially available explosive is used in a versatile and safe slurry form to release high energy in the wellbore. Sustained 200 bopd increases from explosive fracturing have occurred in field tests in producing oil wells. Key fea-tures of the method are wellbore loading with bagged or high viscosity explosive, and solid tamping with cement and gravel. Advantages of the system are: (1) Good explosive-to-formation contact gives maximum energy transfer, (2) High stresses near wellbore cause desirable random fracturing, (3) Concentrated explosive generates highest volume of gases for fracture extension, (4) Casing is not damaged with protective tamping, (5) Cost compares with hydraulic fracturing and (6) The method has applicability to water well development. (Campbell-NWWA)
W71-08476

MATERIALS HANDLING FOR TUNNELING, Holmes and Narver, Inc., Los Angeles, Calif. Ad-

vanced Technology Div.

J. M. Duncan, M. P. Tierney, and H. V. Schneider.

Available from the National Technical Information Service as PB-197 331, \$3.00 in paper copy, \$0.95 in microfiche. Final Report for Office of High Speed Ground Transportation, Urban Mass Transit Administration, Oct 1970. vp.

Descriptors: \*Tunnel, \*Excavation, Materials, Mathematical models, Tunneling machines, Tunnel linings, Pipelines, Construction costs.

Identifiers: \*Subway railways, Hydraulic conveyors, Pneumatic conveyors, Underground sur-

At the tunnel face advance rates anticipated for the future, material handling could become the critical factor in the tunneling project. All functional elements of the tunneling process require materials to be moved by the materials handling system. The characteristics, quantities, and flow of muck, ground support materials, materials for transport system extension, personnel, and other materials and equipment which must be transported between the surface and the work zones are defined. Candidate transport modes to meet the requirements of the future are classified as continuous flow systems or unitized transport systems. Conveyors, hydraulic pipelines, and pneumatic pipelines are selected as representative of continuous flow systems. Conventional dual rail systems with locomotive drive, sidewheel drive and cable drive, siderail systems, monorail systems, hoists, and truck systems are selected for evaluation in the unitized category. These ten transport modes are described, discussed, and analyzed through computerized mathematical models representing the cost/performance relationship for each system. Integrated systems including all elements of the total materials transport system throughout its total life cycle are conceived and analyzed. Based on the results of these evaluations and analyses, areas are identified for beneficial allocation of research and development resources to advance the state of the art of materials handling for tunneling. W71-08668

#### THE SEAFLOOR EXCAVATOR, VOLUME II,

Northrop Corp., Anaheim, Calif. Electro-Mechani-

C. P. Buckley, F. S. Coxe, and O. Shev.

Available from the National Technical Information Service as AD-720 339, \$3.00 in paper copy, \$0.95 in microfiche. Naval Civil Engineering Laboratory Contract Report CR-71.003, Dec 1970, v.p. 66

Descriptors: \*Earth-handling equipment, \*Beds under water, \*Hydraulic systems, \*Dredging, Excavation, Hydraulic systems.

Identifiers: \*Ocean bottom, Underwater vehicles, Deep submergence, Power supplies, Ballast, Data transmission systems, Underwater equipment, Environmental tests, \*Seaflower excavators, \*Underwater excavation, Underwater construction.

The system definition and analysis process through which a deep-ocean Seafloor Excavator is developed is described. Eight concepts are initially formulated and studied, with the three most practi-cal being further developed. A comprehensive system and cost analysis of the three selected concepts is performed to determine the single, most effective concept. The preliminary design and the design specifications for this concept are developed. The resulting design is of a wide-tracked, remotely operated submersible vehicle equipped with a revolving, extendable (jackknife) dredging arm capable of performing earthmoving, excavating dredging tasks in waters as deep as 6000 feet. This report is comprised of four volumes: Volume I contains the summary, Volume II contains the preliminary design and specifications, Volume III contains the concept definition and system analysis studies conducted to establish the preliminary design requirements, and Volume IV contains supporting and supplemental data developed during the course of this program. (See also W71-08867) W71-08866

#### THE SEAFLOOR EXCAVATOR, VOLUME III, Northrop Corp., Anaheim, Calif. Electro-Mechani-

C. P. Buckley, F. S. Coxe, and O. Shev.

Available from the National Technical Information Service as AD-720 340, \$3.00 in paper copy, \$0.95 in microfiche. Naval Civil Engineering Laboratory Contract Report CR-71.003, Dec 1970.

Descriptors: \*Earth-handling equipment, \*Beds under water, \*Dredging, \*Hydraulic systems, Excavation, Trafficability, Buoys, Reliability, Costs. Identifiers: \*Ocean bottom, Environmental tests, Marine engineering, Underwater vehicles, Deep submergence, Booms, Underwater equipment, \*Seafloor excavators, \*Underwater excavation, Underwater construction.

The system definition and analysis process through which a deep-ocean Seafloor Excavator is developed is described. Eight concepts are initially formulated and studied, with the three most practical being further developed. A comprehensive system and cost analysis of the three selected concepts is performed to determine the single, most effective concept. The preliminary design and the design specifications for this concept are developed. The resulting design is of a wide-tracked, remotely operated submersible vehicle equipped with a revolving, extendable (jackknife) dredging arm capable of performing earthmoving, excavating dredging tasks in waters as deep as 6000 feet. This report is comprised of four volumes: Volume I contains the summary, Volume II contains the preliminary design and specifications, Volume III contains the concept definition and system analysis studies conducted to establish the preliminary design requirements, and Volume IV contains supporting and supplemental data developed during the course of this program. (See also W71-08866) W71-08867

#### 8I. Fisheries Engineering

THE MARINE AND COASTAL FISHERIES STA-TIONS OF THAILAND.

Alabama Agricultural Experiment Station, Au-

H. S. Swingle, and R. O. Smitherman.

Available from the National Technical Information Service as PB-195 911, \$3.00 in paper, \$0.95 in microfiche. July 30, 1969. 22 p, 17 fig.

Descriptors: \*Fisheries, \*Stations, \*Fish farming, \*Research facilities, Equipment, Ponds.

Identifiers: \*Thailand.

The Thailand marine stations at Phuket and Rayong, the coastal stations at Prachuap Khiri Khan, Chantaburi and Songkla and the shrimp stations at Samut Sakhon are described. The research projects, personnel, facilities, transportation and equipment are presented for each station. (Ensign-PAI) W71-08743

EFFECTS OF GRAVEL CLEANING ON BOT-TOM ORGANISMS IN THREE SOUTHEAST ALASKA STREAMS,
Pacific Northwest Forest and Range Experiment

Station, Juneau, Alaska.

William R. Meehan.

Progressive Fish-Culturist, Vol 33, No 2, p. 107-111, Apr 1971.

Descriptors: \*Benthic fauna, \*Stream improvement, \*Sedimentation, \*Streambeds, Invertebrates, Aquatic insects, Amphipoda, Annelids, Alaska, Pacific coast region.

Identifiers: \*Gravel cleaning, \*Sediment reduction,

Riffer sifter, Southeast Alaska.

Sections of streambed in three southeast Alaska streams were cleaned by means of a mechanical 'riffle sifter.' Bottom fauna populations were sampled before and after gravel cleaning to determine the effect of this operation on fish food organisms. Results indicate that invertebrate populations were reduced as a result of cleaning, but that they returned to pre-treatment levels of abundance within a year after gravel cleaning. W71-08853

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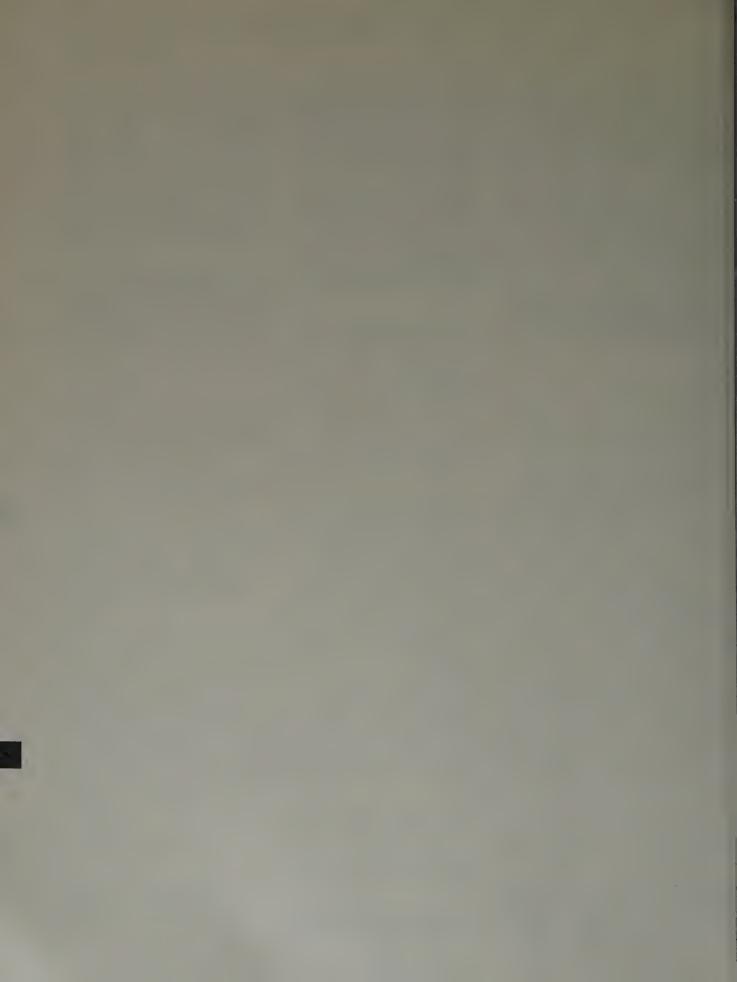
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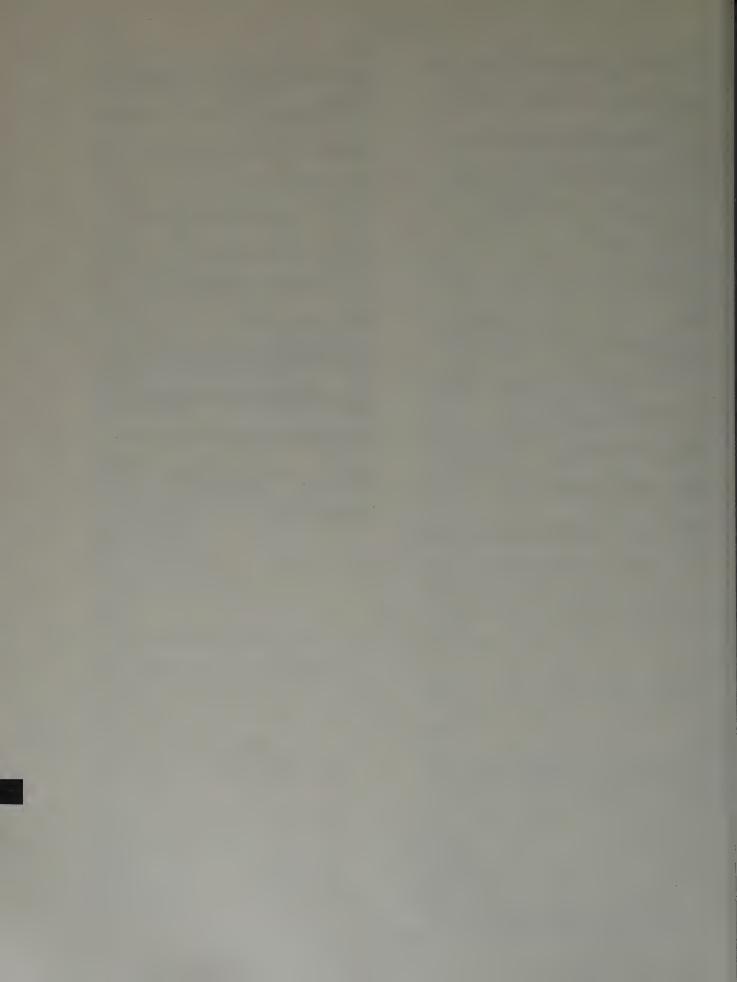
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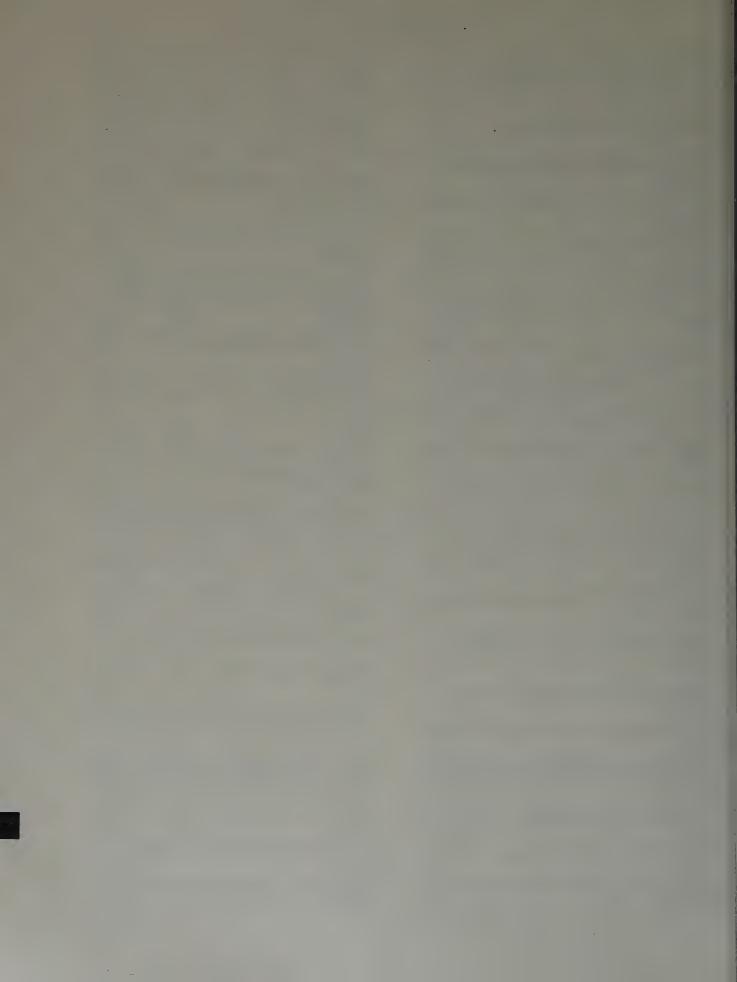
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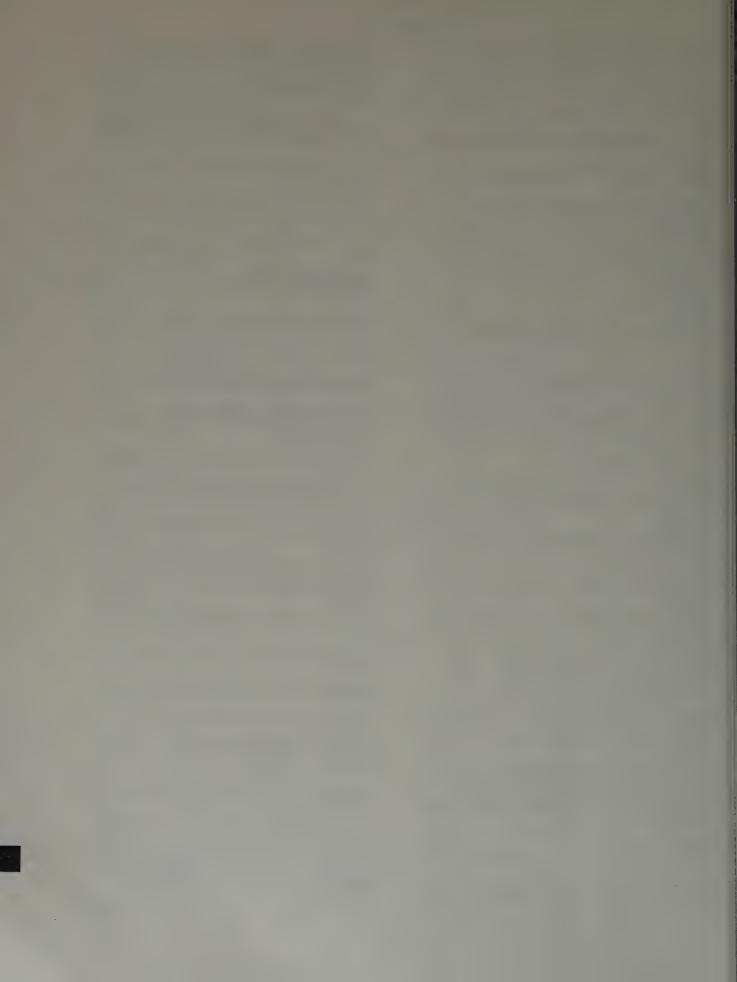
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### CENTERS OF COMPETENCE AND THEIR SUBJECT COVERAGE

- Ground and surface water hydrology at the Water Resources Division of the U. S. Geological Survey, U. S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources
   Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers
  University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the EPA-Water Quality Office, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.
- Water well construction technology at the National Water Well Association.
- Water-related aspects of nuclear radiation and safety at the Oak Ridge National Laboratory.

Supported by the Environmental Protection Agency in cooperation with WRSIC.

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.
- Agricultural livestock wastes at the Department of Agricultural Engineering of Iowa State University.
- Methods for chemical and biological identification and measurement of pollutants at the Analytical Quality Control Laboratory of the Water Quality Office of the Environmental Protection Agency.
- Coastal pollution at the Oceanic Research Institute.
- Water treatment plant waste pollution control at American Water Works Association Research Foundation.

## **Subject Fields**

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